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INTEGRATED REGULATORY REVIEW SERVICE (IRRS)

MISSION

TO

PEOPLE'S REPUBLIC OF CHINA

Beijing, People's Republic of China

18 to 30 July 2010

DEPARTMENT OF NUCLEAR SAFETY AND SECURITY

INTEGRATED REGULATORY REVIEW SERVICE (IRRS)
REPORT TO
THE GOVERNMENT OF THE PEOPLE'S REPUBLIC OF CHINA

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Mission date: *18 to 30 July 2010*

Regulatory body: *NNSA*

Location: *Beijing, China*

Regulated facilities and practices: *Nuclear power plants, research reactors, fuel cycle facilities, medical industrial and research facilities, waste facilities, decommissioning and remediation.*

Organized by: *International Atomic Energy Agency (IAEA)*

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The number of recommendations, suggestions and good practices is in no way a measure of the status of the regulatory body. Comparisons of such numbers between IRRS reports from different countries should not be attempted.

TABLE OF CONTENT

EXECUTIVE SUMMARY

At the request of the government of the People's Republic of China, an international team of twenty-two senior experts in safety regulation visited the National Nuclear Safety Administration (NNSA)， Ministry of Environmental Protection (MEP) of the People's Republic of China from 19 to 30 July 2010 to conduct an Integrated Regulatory Review Service (IRRS) mission.

The purpose of this IRRS mission was to review the framework for regulating safety of all nuclear facilities and activities and radioactive sources of the People's Republic of China and the effectiveness of regulatory functions implemented by MEP (NNSA) and other governmental authorities. The review was carried out by comparison against IAEA safety standards – IAEA Safety Fundamentals and Safety Requirements and Guides – and the Code of Conduct on the Safety and Security of Radioactive Sources as the international benchmark for safety. The mission was also used to exchange information and experience between the IRRS Review Team and the Chinese counterparts in the areas covered by IRRS.

The IRRS Review Team consisted of seventeen senior regulatory experts from fifteen Member States, four staff members from the IAEA and an IAEA administrative assistant. The IRRS Review Team carried out the review of the MEP (NNSA), its Technical Support Organization and other governmental authorities in all relevant areas: responsibilities and functions of the government, global safety regime, responsibilities and functions of the regulatory body; the management system of the regulatory body, the activities of the regulatory body including the authorization, review and assessment, inspection and enforcement processes, regulations and guides, and emergency preparedness and response.

The IRRS review addressed facilities and activities regulated by MEP (NNSA), including the operation of nuclear power plants, research reactors, fuel cycle facilities, industrial, medical and research facilities, and waste management facilities. The review also addressed implementation of the Code of Conduct on Safety and Security of Radioactive Sources. Transport, medical exposure and nuclear security were not part of the IRRS scope.

The mission included observations of regulatory activities at facilities and a series of interviews and discussions with the staff of other organizations to help assess the effectiveness of the system. These involved the following site visits: Qinshan NPP, China North Nuclear Fuel Co. Ltd, Shanghai Electric Group, Tsinghua University, Tianjin JPY Ion-Tech. Co., Peking Union Medical College Hospital, and Guangdong Beilong Medium and Low level Waste Disposal Facility. The IRRS Review Team conducted interviews with the Ministry of Health（MOH), Nuclear and Radiation Safety Center (NSC), National Energy Administration (NEA), China Atomic Energy Authority (CAEA), China National Nuclear Corporation (CNNC), and China Guangdong Nuclear Power Corporation (CGNPC).

In addition, four policy issues were addressed and discussed with MEP (NNSA) senior management and staff: regulatory independence and effectiveness, regulatory oversight during construction of an NPP, human resources and knowledge management at the regulatory body and international cooperation and collaboration of the regulatory body.

MEP (NNSA) provided the IRRS Review Team with initial documentation as advanced reference material and results of the self-assessment, including a report with conclusions and an action plan with measures to improve its regulatory effectiveness. In addition, the IRRS Review Team also reviewed the implementation of the IAEA recommendations from the previous International Regulatory Review Team (IRRT) mission in 2000 and follow-up mission in 2004.

Throughout the mission, the IRRS Review Team was extended full cooperation in technical, regulatory, and policy discussions by all parties; in particular the staff of MEP (NNSA) provided the fullest practicable assistance.

The IRRS Review Team identified a number of good practices, made recommendations and suggestions that indicate where improvements are necessary or desirable to continue enhancing the effectiveness of regulatory functions in comparison with the IAEA safety standards. The IRRS Review Team noted the impressive programme for nuclear development involving the construction and bringing into operation of around 100 nuclear power units by 2020. As a consequence, there will be a need for a compatible programme of other nuclear fuel cycle facilities, research facilities and activities. This report should be seen in that context.

The IRRS Review Team noted that the particular social, economic and cultural environment coupled with a fundamental commitment to a "safety first, quality first" principle and the extensive use of IAEA safety standards provides a unique potential to execute such a programme to world leading standards of safety. Care will be necessary to ensure that the essential positive cultural and capability attributes of this environment are preserved throughout the decades to come.

The IRRS Review Team observed that a comprehensive nuclear regulatory framework, including regulatory organizations, based on IAEA safety standards is in place in the People's Republic of China. As part of implementing the State policy in nuclear and radiation safety assurance, a regulatory organizational structure was reformed in 1998, 2003 and 2008 successively, putting the nuclear regulator under the jurisdiction of the MEP. The IRRS Review Team expects that this will need further time and effort to develop its full effectiveness, especially in light of the accelerating programme of nuclear development. This will require strong support from the government for ensuring that appropriate sustained funding and flexibility are provided.

Some good practices identified by the IRRS Review Team are:

- The long term (2005-2020) nuclear power development plan issued in October 2007 and the long term plan (2006-2020) on nuclear safety and radioactive pollution prevention in 2007 include a clear nuclear policy statement – "adhere to the safety first/quality first principle", and a commitment to strengthen the supervision of nuclear safety and its enforcement;
- MEP (NNSA) has made available the basic conditions covering, inter alia, organisational, resource and safety culture factors for companies wishing to acquire a licence to have access to Chinese nuclear markets;
- The MEP (NNSA) recommendations for universities and other training of engineers in some professional areas are very useful;
- The qualification and registering of nuclear safety engineers in China;
- The authorization procedures and regulations concerning Chinese organizations involved with nuclear safety equipment have been developed in recent years. The regulatory supervision has been strengthened and is organized in an effective way;
- The MEP (NNSA) training programme for inspectors includes simplified reactor behaviour simulation training as well as licensee provided material on site equipment and systems; and
- MEP (NNSA) has initiated periodic meetings between Chinese nuclear utilities to promote the exchange of important safety related information.

The IRRS Review Team identified some priority issues in need of improvement and believes that consideration of these items would enhance the overall performance of the regulatory system.

- The Chinese government/MEP (NNSA) should issue as soon as practicable an expanded nuclear policy and strategy for safety, expedite the promulgations of nuclear laws such as the Atomic Energy Act and/or Nuclear Safety Act, draw up a comprehensive national policy and strategy for the management of radioactive waste and spent nuclear fuel and clearly define the role of the

relevant authorities in enforcing standards and regulations. The requirement to assign prime responsibility for nuclear safety to the organizations responsible for the facilities or activities should be clearly defined in the new laws to be promulgated;

- The Chinese government should establish the regulator, NNSA, as a real integrated regulatory Authority (Administration or Agency) within MEP with the appropriate competencies with a Vice Minister as its Administrator and Head, and a chief nuclear safety engineer as technical assistant. The chief nuclear safety engineer should be solely focused on technical decision-making on safety regulation given its importance and nuclear power expansion. MEP (NNSA) should assess its current and future needs for internal technical expertise considering especially its decision-making functions;
- The government should allocate adequate financial and human resources, of the appropriate competencies, for developing and maintaining the regulatory infrastructure in China commensurate with the current rapid development of its nuclear power programme;
- The government should provide MEP (NNSA) with sufficient flexibility, to ensure that the regulatory body can attract and retain the suitably qualified and experienced regulatory staff that it will require;
- The government should establish mechanisms for the effective coordination of the regulatory functions amongst MoH, provincial DoH, MEP and provincial EPA to ensure complete and clear coverage and coordination. In addition, MOH should ensure managing, controlling and recording the doses received by emergency workers for different types of response activities;
- MEP (NNSA) should further improve and implement an integrated management system in accordance with GS-R-3;
- MEP (NNSA) should develop regulations for decommissioning plans for existing as well as for planned nuclear installations, specifying when decommissioning plans should be drawn up, the scope, content and the period of revision;
- MEP NNSA should strengthen the auditing programme in foreign manufactory for quality assurance of equipment to be used in Chinese NPPs;
- The regulator's capability to perform independent verification of safety assessments needs to be strengthened. Adequate resources for regulatory review and assessment activities should be secured taking into account the rapid expansion of the Chinese nuclear programme. MEP (NNSA) should ensure that safety analyses results shall be verified with analyses performed by experts independent from the authors of the application;
- MEP (NNSA) should align the Evaluation Principles used in review and assessment with existing regulations; and
- The need for intensive exchange of operating experiences could substantially benefit nuclear safety in China as well as other countries by learning from each other.

The IRRS Review Team findings are summarized in Appendix V. An IAEA press release was issued at the end of the mission.

I. INTRODUCTION

At the request of the government of the People's Republic of China, an international team of twenty two experts in nuclear, radiation and radioactive waste safety visited the MEP (NNSA) from 19 to 30 July 2010, to conduct an Integrated Regulatory Review Service (IRRS) mission to review the Chinese nuclear regulatory framework and its effectiveness. In April 2010, a preparatory meeting had been carried out in Beijing to discuss the objective and purpose of the review as well as its scope in connection with aspects of the work of MEP (NNSA), its Technical Support Organizations (TSOs) and other governmental authorities involved in regulations of nuclear power, sources and waste.

The IRRS Review Team consisted of 17 senior regulatory experts from 15 Member States, four staff members from the IAEA and an IAEA administrative assistant. The IRRS Review Team carried out the review of the MEP (NNSA), its TSOs and other Ministries in all relevant areas: responsibilities and functions of the government, nuclear safety regime; responsibilities and functions of the regulatory body; the management system of the regulatory body, the activities of the regulatory body including the authorization, review and assessment, inspection and enforcement processes, regulations and guides, management systems and emergency preparedness and response.

The IRRS review addressed facilities and activities regulated by MEP (NNSA), including the operation of nuclear power plants, research reactors, fuel cycle facilities, industrial, medical and research facilities, and waste management facilities. The review also addressed implementation of the Code of Conduct on Safety and Security of Radioactive Sources. Transport, medical exposure and nuclear security modules were not part of the IRRS scope.

In addition, policy issues were addressed, including: regulatory independence and effectiveness, regulatory oversight during construction, human resources and knowledge management at the regulatory body, and international cooperation and collaboration of the regulatory body.

MEP (NNSA) prepared substantial documentation as advance reference material and a well prepared self-assessment. During the mission the IRRS Review Team performed a systematic review of all topics using the advance reference material, held interviews with senior management and staff from MEP (NNSA), its Technical Support Organizations (TSOs) and other governmental authorities involved in regulations of nuclear power, sources and waste and performed direct observation of the working practices during inspections carried out by MEP (NNSA).

The mission included observations of regulatory activities at facilities and a series of interviews and discussions with the staff of other organizations to help assess the effectiveness of the system. These involved the following site visits: Qinshan NPP, China North Nuclear Fuel Co. Ltd, Shanghai Electric Group, Tsinghua University, Tianjin JPY Ion-Tech. Co., Peking Union Medical College Hospital, and Guangdong Beilong Medium and Low level Waste Disposal Facility. The IRRS Review Team conducted interviews with the Ministry of Health（MOH), Nuclear and Radiation Safety Center (NSC), National Energy Administration (NEA), China Atomic Energy Authority (CAEA), China National Nuclear Corporation (CNNC), and China Guangdong Nuclear Power Corporation (CGNPC).

II. OBJECTIVE AND SCOPE

The purpose of this IRRS mission was to conduct a review of the Chinese nuclear regulatory framework and regulatory activities as applied to all regulated sources, facilities and activities, to review its regulatory effectiveness and to exchange information and experience in the areas covered by IRRS. The review was carried out by comparison against IAEA safety standards (Appendix VI) and the Code of Conduct on the Safety and Security of Radioactive Sources as the international benchmark for safety. The IRRS mission was performed using the new Safety Requirements for Governmental, Legal and Regulatory Framework for Safety (IAEA Safety Standards Series No. GSR Part 1) approved at the March 2010 Board of Governors Meeting.

It is expected that the IRRS mission will facilitate regulatory improvements in the People's Republic of China and throughout the world from the knowledge gained and experiences shared by MEP (NNSA) and the IRRS reviewers and through the evaluation of the effectiveness of the Chinese nuclear regulatory framework and its good practices.

The key objectives of this mission were to enhance nuclear and radiation safety and nuclear security by:

- ✓ Providing MEP (NNSA), through completion of the IRRS questionnaire, with an opportunity for self-assessment of its activities against international safety standards;
- ✓ Providing the People's Republic of China (MEP (NNSA) and other governmental authorities) with a review of their regulatory programmes and policy issues relating to nuclear and radiation safety;
- ✓ Providing the People's Republic of China (MEP (NNSA) and other governmental authorities) with an objective evaluation of their nuclear and radiation safety regulatory activities with respect to international safety standards;
- ✓ Contributing to the harmonization of regulatory approaches among Member States;
- ✓ Promoting the sharing of experience and exchange of lessons learned;
- ✓ Providing reviewers from Member States and the IAEA staff with opportunities to broaden their experience and knowledge of their own field;
- ✓ Providing key staff with an opportunity to discuss their practices with reviewers who have experience of other practices in the same field;
- ✓ Providing the People's Republic of China (MEP (NNSA) and other governmental authorities) with recommendations and suggestions for improvement; and
- ✓ Providing other States with information regarding good practices identified in the course of the review.

III. BASIS FOR THE REVIEW

A) PREPARATORY WORK AND IAEA REVIEW TEAM

At the request of the Chinese government authorities, a preparatory meeting for the Integrated Regulatory Review Service (IRRS) was conducted from 22 to 23 April 2010. The preparatory work for the mission was carried out by the appointed Team Leader, Mr Michael Weightman, Deputy Team Leader, Mr Shahid Mallick, and the IRRS IAEA Team Coordinator Mr Gustavo Caruso.

The IRRS Review Team had extensive discussions regarding regulatory programmes and policy issues with the senior management of MEP (NNSA) represented by Mr Liu Hua, Director General of the Department of Nuclear and Radiation Safety, MEP (NNSA), and some of its senior management and staff.

The Liaison Officer for the IRRS mission was Mr Jiang Wei. The discussions resulted in the following areas to be covered by the IRRS mission:

- Nuclear power plants;
- Research reactors;
- Fuel cycle facilities;
- Medical, industrial and research facilities and activities;
- Waste management facilities;
- Code of Conduct on Safety and Security of Radioactive Sources;
- Emergency preparedness and response; and
- Selected policy issues.

Mr Liu Hua made a comprehensive presentation on the self-assessment results and other advanced reference material. IAEA presented the IRRS principles and methodology, including the self-assessment phase. This was followed by a discussion on the work plan for the implementation of the IRRS in the People's Republic of China in July 2010.

The proposed IRRS Review Team composition (senior regulators from Member States to be involved in the review) was discussed and the size of the IRRS Review Team was confirmed. Logistics including meeting and work space, counterpart identification, lodging and transportation to accommodate site visits and observations were also addressed.

In May 2010, MEP (NNSA) provided IAEA with the advance reference material for the review, including the self-assessment report.

B) REFERENCE FOR THE REVIEW

The most relevant IAEA safety standards used as review criteria are: General Safety Requirement (GSR) Part 1, Safety Requirements on Governmental, Legal and Regulatory Framework for Safety (revision of GS-R-1, approved during the March 2010 Board of Governor's Meeting); GS-R-3, Safety Requirements on the Management System for Facilities and Activities; the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (the BSS); and the Code of Conduct on the Safety and Security of Radioactive Sources.

The complete list of IAEA publications used for this mission is given in Appendix VI.

C) CONDUCT OF THE REVIEW

An opening IRRS Review Team meeting was conducted on Sunday, 18 July 2010 in Beijing by the IRRS Team Leader, the IRRS Deputy Team Leader, the IRRS IAEA Team Coordinator and the IRRS IAEA

Deputy Team Coordinator to discuss the specifics of the mission, to clarify the basis for the review and the background, context and objectives of the IRRS and to agree on the methodology for the review and the evaluation among all reviewers.

The opening remarks were given by Mr Li Ganjie, Vice Minister of the MEP and Administrator of the NNSA. Mr Liu Hua and other senior managers of MEP (NNSA) gave presentations at the opening IRRS Review Team meeting, in accordance with the IRRS guidelines. The reviewers also reported their first impressions of the advance reference material. In addition, approximately 20 officials and staff from MEP (NNSA) were also in attendance.

The IRRS entrance meeting was held on Monday, 19 July 2010, with the participation of MEP (NNSA) senior management and staff. Opening remarks were made by Mr Li Ganjie, the IRRS Team Leader and the IRRS Deputy Team Leader.

During the mission, a systematic review was conducted for all the review areas with the objective of providing MEP (NNSA) and other government authorities with recommendations and suggestions as well as identifying good practices. The review was conducted through meetings, interviews and discussions, visits to relevant organizations and direct observations regarding the national practices and activities.

The IRRS Review Team performed its activities based on the mission programme given in Appendix II.

The IRRS exit meeting was held on Thursday, 29 July 2010. The opening remarks at the exit meeting were presented by Mr Li Ganjie. The results of the IRRS mission were presented by Mr Michael Weightman. The closing remarks were made by Mr Taniguchi, Deputy General of the IAEA Department of Nuclear Safety and Security and Mr Li Ganjie.

1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT

1.1. NATIONAL POLICY AND STRATEGY

Establishment of the National Policy and Strategy

The State policy is defined by different law, regulations, and strategy plans in China. Among them, the Long Term Nuclear Power Development Plan for 2005-2020, prepared by National Development and Reform Commission (NDRC), approved by the State Council in October 2007, clearly states the long term commitment to safety based on the policy of "safety first/quality first". The IRRS Review Team's interactions confirmed that this principle is embedded in the culture of the government, regulatory bodies, and industry. This plan also specifies the government commitment to strengthen nuclear safety by expediting the promulgation of law and regulations for regulating nuclear safety and security and providing enhanced mechanism for enforcement and emergency preparedness, and more specifically the "Atomic Energy Act". These commitments will be need to be nurtured and enhanced over the years to come given the continued changes in the Chinese economy and society.

The national policy takes into account the need for provision of human and financial resources, as well as, enhancement of research and development for a safe and sustainable nuclear power programme. In general terms, the policy is in agreement with the IAEA Safety Fundamentals (SF-1), but it does not explicitly address all the ten safety principles. In addition to the development of the "Atomic Energy Act", which involves input from a wide range of organizations, there is a plan to promulgate a "Nuclear Safety Act" within the next three years. This act will consolidate earlier laws and regulations such as HAF001 "Regulations on the Safety Regulation for Civil Nuclear Installations of the People's Republic of China" and is expected to enhance safety and regulatory infrastructure to keep pace with rapid nuclear power development. The "Nuclear Safety Act" is being drafted and led by the National Nuclear Safety Administration (NNSA) that is part of the Ministry of Environmental Protection (MEP). The NDRC with the assistance of MEP (NNSA) is also formulating a policy on nuclear safety.

The plan to promulgate laws, such as the proposed Atomic Energy Act and the Nuclear Safety Act that integrates all of MEP (NNSA)'s required legal bases in one place was identified by the IAEA IRRT follow up mission in 2004. In support of the Long Term Development Plan, the National Energy Administration (NEA), through the NDRC, is also developing a five year Nuclear Safety Plan with input from the MEP (NNSA).

Graded Approach

IRRS Review Team observed clear indications of a graded approach to the implementation of the regulatory framework; however, the use of a graded approach to regulatory process could be enhanced. For example, there is a clear categorization of radiation sources based on associated risks, but the same regulatory processes are applicable to the authorized parties irrespective of the associated risk.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GS-R-Part 1 - Requirement 1: National policy and strategy for safety states that** *"The government shall establish a national policy and strategy for safety, the implementation of which shall be subject to a graded approach in accordance with national circumstances and with the radiation risks associated with facilities and activities, to achieve the fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals."*
R1	**Recommendation: The government/MEP (NNSA) should compile one document as soon as practicable, in which an expanded nuclear policy and strategy for safety that covers compliance with the ten safety principles as given in IAEA Safety Fundamentals (SF-1)**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	should be included, taking account the current and future challenges faced by the government, regulatory body and the industry.
S1	**Suggestion: The MEP (NNSA) should consider enhancing the application of the graded approach in the implementation of the national policy and strategy for safety.**
GP1	**Good Practice: The long term (2005-2020) nuclear power development plan issued in October 2007 and the long term (2006-2020) plan on nuclear safety and radioactive pollution prevention issued in October 2007, include a clear nuclear policy statement – adhere to the "safety first/quality first principle", and a commitment to strengthen the supervision of nuclear safety and its enforcement.**

1.2. ESTABLISHMENT OF A FRAMEWORK FOR SAFETY

The legislative framework in the People's Republic of China (PRC) is composed of national laws, administrative regulations of the State Council, departmental rules, guidance and reference documents. The national laws, which are enacted by the National People's Congress and its Standing Committee, have a higher legal status than the administrative regulations and departmental rules. Administrative regulations are promulgated by the State Council and departmental rules are issued by the relevant ministries of the State Council and both are legally binding. Safety guides on nuclear and radiation safety are guidance documents that explain or supplement safety regulations and recommend methods and procedures to implement safety codes formulated and promulgated by State Council's relevant departments while technical documents are references to nuclear and radiation safety technologies formulated and promulgated by relevant departments of the State Council or their respective organizations.

The IRRS Review Team noted that the government of PRC has promulgated a set of laws, administrative regulations by the state council and relevant ministries of the State Council that are legally binding establishing the regulatory framework in nuclear, radiation, waste and transport safety. The principal laws and regulations defining the legislative regulatory framework in China are given in Annexes I and II of the advanced reference material (ARMS).

It is noted by the IRRS Review Team that the purpose of the Law on Prevention and Control of Radioactive Pollution is "to prevent radioactive pollution, to protect the environment and human health, to promote nuclear energy, and to promote the development and peaceful use of nuclear technology". It is more common that legislation for the protection of health and the environment is kept separate from legislation of promotional nature.

This legal framework takes account of:

- safety principles for protecting the workers, public and the environment;
- the types of facilities and activities and the potential hazard associated with them;
- provision for the involvement of the interested parties and for their input into decision making;
- assigning that the prime responsibility for safety lies with the operating organization responsible for the facilities and activities, and for ensuring the continuity of responsibility where activities are carried out by several persons or organizations successively;
- provision for the authorization and review and assessment of facilities and activities, in accordance with a graded approach;

- assigning responsibility of the regulatory body for promulgating (or preparing for enactment) regulations and preparing guidance for their implementation;
- provision for the inspection of facilities and activities and for the enforcement of regulations, in accordance with a graded approach;
- provision for appeal against decisions of the regulatory body;
- provision for preparedness for and response to a nuclear or radiological emergency;
- responsibilities and obligations in respect of financial provision for the management of radioactive waste and of spent fuel, and for decommissioning of facilities and termination of activities;
- the criteria for release from regulatory control; and
- the specification of offences and the corresponding penalties.

The legislative framework for safety in the People's Republic of China is comprehensive, including legal and regulatory elements and the allocation of responsibilities for safety, and heavily based on IAEA safety standards. The IRRS Review Team noted that the regulatory system is comprehensive but fragmented and contained in many documents with different administrative and jurisdictional level that requires consolidation. Additionally, it is considered to be somewhat out of date, especially in light of the practicalities of the leap forward in nuclear development. The government in its Policy document has indicated its willingness to consolidate and update the legal framework by expediting the development and promulgation of the "Atomic Energy Act". Alongside this Act, it is also envisaged to develop a "Nuclear Safety Act" to strengthen nuclear and radiation safety in the country.

The IRRS Review Team, based on the review of document and discussions with counterparts, consider that there is an urgent need to further strengthen the legislative and regulatory framework in China considering the rapid expansion of nuclear power development programme in China. It noted that there is a 5-year plan for an extensive development of the regulations. One of the challenges in strengthening the legal and regulatory framework is that in terms of accelerating the development of the nuclear laws and associated regulations, to respond to the rapid nuclear power programme expansion, the institutions responsible for their development are likely to be challenged in terms of resource capacity.

The government of the PRC has also established a process, through the NDRC and China Atomic Energy Authority- CAEA, to issue quality and management focused approvals to companies wishing to access the market to provide services and supplies to research institutes, uranium mining facilities and other nuclear facilities. This is considered to be a good practice.

China also places high importance to IAEA safety standards and the use of IAEA safety standards in the regulatory system. The system of the IAEA safety standards was taken as a basis of the PRC nuclear safety related legislation. This is reflected in the law and regulations, Five Years Legislative Plan (2010-2015) by MEP (NNSA) and other related documents. However, the IRRS Review Team has observed that in some cases the development of national legislation was delayed because of the expectations of the near future changes of relevant IAEA Standards or Guides. Where there is a need for legislation, then it should be developed in a timely fashion even if it means not waiting for relevant IAEA Standards or guides to be developed.

The IRRS Review Team identified an issue of implementation of regulatory responsibility for radiation protection regarding occupational radiation workers as is given the International Basic Safety Standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources (BSS-115) which is adopted in the national regulation. The Chinese BSS is issued as mandatory Standards by the "General Administration of Quality Supervision, Inspection and Quarantine" and is implemented by governmental

agencies and industries. However, this could lead to gaps in regulatory control if no authority feels itself responsible to enforce the requirements fully or in part, overlaps if more than one authority considers itself in charge, or no authority accepting responsibility when radiation harm arises due to lack of enforcement.

Indeed the IRRS Review Team's observations on the implementation of regulatory requirements related to e.g. occupational exposure control, are partly related to conflicting understanding of roles as to what each authority's responsibilities are with respect to enforcing BSS requirements. Both MEP（NNSA）and MOH have the responsibilities on occupational exposure control from different laws' authorization, e.g. MEP (NNSA) is responsible for radiation protection for environment, public and occupational workers in China, while the MOH is responsible for occupational exposure control. Although a duplicate responsibility on occupational workers, it is better for radiation protection.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 2 states that** *"The government shall establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities are clearly allocated."*
(2)	**BASIS: GSR Part 1 Requirement 2: Establishment of a framework for safety §2.5 states that** *"The government shall promulgate laws and statutes to make provision for an effective governmental, legal and regulatory framework for safety."*
R2	**Recommendation: The government should expedite the promulgations of nuclear laws such as Atomic Energy Act and Nuclear Safety Act, consolidating and updating the nuclear safety infrastructure in China in such a way that it complies with GSR Part 1 requirements taking account of the rapid development of the nuclear power programme. Efforts should be made to complete the promulgations process within a reasonable time frame.**
S2	**Suggestion: The regulatory authorities should ensure that in the implementation of regulations covering the Basic Safety Standard there is no gaps or unnecessary overlaps in assessment, inspection and enforcement.**
S3	**Suggestion: The government should adequately strengthen institutions to respond to the development of the nuclear laws and associated regulations.**
GP2	**Good Practice: MEP (NNSA) has made available the basic conditions covering, inter alia, organisational, resource and safety culture factors for companies wishing to acquire a licence to have access to Chinese nuclear markets.**

1.3. ESTABLISHMENT OF A REGULATORY BODY

MEP (NNSA) was established in 2008, replacing the SEPA (NNSA), as the regulatory body in China for nuclear safety, radiation safety and radiological environment management. The establishment of MEP (NNSA) as a name rather than a real body is recorded in an official document which articulates the high level responsibilities of the MEP (NNSA). The more detailed responsibilities of the MEP (NNSA), within the boundaries of this document, are provided in the regulation HAF 001. Its organizational standing and structure is set down in the governmentwide legal document establishing the government's administrative structures. These are reviewed every 5 years. At present this constrains the ability to develop a more integrated nuclear real regulatory body in the MEP that is necessary to face the challenges of the leap forward in nuclear power and the consequential need for a significant growth in the MEP (NNSA). It is concluded that a change in the establishment of the MEP (NNSA) is required to enable such a change to

take place. It is understood that this is agreed within the MEP but has yet to be taken through the State Council.

MEP (NNSA) has it's headquarter in Beijing, with six regional offices located at Shanghai, Shenzhen, Chengdu, Beijing, Lanzhou and Dalian. The Provincial Environmental Protection Administration Bureau (provincial EPB) in each of the 31 provinces of China provides regulatory oversight for the radioactive sources and radiation generators other than Category 1, while MEP (NNSA) provides regulatory oversight for category 1 sources. The Ministry of Health (MOH) also provides regulatory oversight for medical applications of radiation sources. The arrangements for the MOH are also covered by the 5-year agreement on governmental administrative structure agreed through the Congress outlined above.

MEP (NNSA) is headed by the Vice Minister (VM) who has a nuclear technical background. Under his supervision there are two departments in headquarters namely, the Department of Nuclear and Radiation Safety and the Department of International Cooperation as well as the in-house dedicated technical support organization (TSO), Nuclear and Radiation Safety Centre (NSC). The Department of Ecology, although not a part of the MEP (NNSA), is also under the supervision of the VM. The Department of Nuclear and Radiation Safety is headed by a Director General and comprises twelve technical divisions which look after all the nuclear installations including nuclear power plants (NPPs), research reactors, nuclear fuel cycle, radioactive sources and radiation generators, nuclear safety equipment, environmental radiological monitoring etc.

MEP (NNSA) has also established an Expert Committee of Nuclear and Radiation Safety Regulations, comprising of 100 imminent experts from universities, technical institutes and industry to take technical advice on development of safety regulations, technical development and regulatory review. Additionally, an eminent very experienced engineer is retained as the Chief Nuclear Engineer reporting directly to the Vice Minister to represent the Minister when necessary but has no terms of reference for his work.

Some of the challenges identified by the IRRS Review Team include the capacity and competence of human resources and also financial resources available for the MEP (NNSA) to fulfil its regulatory activities especially taking into consideration the rapid expansion of the nuclear power programme in China. This would require a major increase in human and financial resources.

Although major increases in staff and associated financial resources have been approved by government for the MEP (NNSA) including its regional offices and technical support organizations (NSC), MEP (NNSA) still lacks some flexibility, within the policies and procedures of the government, to be competitive for recruiting experienced staff. Without some mechanisms being provided for MEP (NNSA) to be more competitive in a market, which will only get more difficult, it is difficult to see how the necessary experienced regulatory workforce can be established and maintained. Without such a workforce then undue constraints on the optimum progress of nuclear power development will naturally occur. The IRRS Review Team notes that further growth beyond what was already agreed by the government is likely to be needed.

These challenges and the development of MEP (NNSA) into a real integrated regulatory body, will need enhanced high level attention and dedication. This may mean that the Vice Minister's and chief nuclear safety engineer's range of responsibilities will need to be reassessment, so that the chief nuclear safety engineer become solely focused on technical decision making on the regulatory body, in view of the rapid development of nuclear power, different regulating activities (environmental protection and ecology) and different departments possibly affect the regulatory efficiency and effectiveness.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 3: Establishment of a regulatory body states that** *"The government, through the legal system, shall establish and maintain a regulatory body, and shall confer on it the legal authority and provide it with the competence and the resources necessary to fulfil its statutory obligation for the regulatory control of facilities and activities."*
R3	**Recommendation: In effectively responding to the increasing safety challenges of rapid development of nuclear power, the government should strengthen the NNSA as a real integrated regulatory Authority (Administration or Agency) within the MEP with a Vice Minister as its Administrator and Head mainly focused on safety regulation, so as to enable the MEP (NNSA) to mobilize and use management resources in more efficient and intensive way**.
R4	**Recommendation: The Government should allocate adequate financial and human resources, of the appropriate competencies, for developing and maintaining the regulatory infrastructure in China commensurate with the current and the rapid development of its nuclear power programme.**
R5	**Recommendation: The Government should provide MEP (NNSA) with sufficient flexibility, to ensure that the regulatory body can attract and retain the suitably qualified and experienced regulatory staff that it will require.**

1.4. INDEPENDENCE OF THE REGULATORY BODY

The nuclear regulatory body is established as a State Administration of the Ministry of Environmental Protection (MEP), which is by itself independent from other governmental branches that promulgate the use of nuclear energy. The IRRS Review Team did not find any issues related to the effective independence of the MEP (NNSA) in terms of reporting in Government structure that could potentially put undue influence in its regulatory decision making.

1.5. PRIME RESPONSIBILITY FOR SAFETY

Article 12 of the Law of the People's Republic of China on Prevention and Control of Radioactive Pollution clearly assigns responsibility of a nuclear installation to its operator. In addition Article 7 of Regulations HAF-001 assigns prime responsibility for nuclear safety to the operating organizations. This requirement is also articulated in the " Code on the Safety of Nuclear Power Plant Operation, HAF-103" These clear legal requirements are expected to be further enhanced in the foreseen new law on nuclear safety along with other related aspects (see for example 1.6).

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 5 Prime Responsibility for Safety states that "***The government shall expressly assign the prime responsibility for safety to the person or organization responsible for a facility or an activity, and shall confer on the regulatory body the authority to require such persons or organizations to comply with stipulated regulatory requirements, as well as to demonstrate such compliance."*
R6	**Recommendation: Although the current regulations assign the prime responsibility for nuclear safety to the organization responsible for the facilities or activities, this requirement should also be clearly defined in the new laws to be promulgated.**

1.6. COMPLIANCE WITH REGULATIONS AND RESPONSIBILITY FOR SAFETY

From the review discussions with the regulatory bodies, industry and others, it was clear that the industry has a strong commitment to the "safety first/quality first principle" and has developed strong safety cultures as demonstrated by the ownership for nuclear safety and actions of their leaders. This extends beyond their legal requirements and such behaviours and commitment of leaders is difficult to legislate for, let along regulate. However, it is a major strength of the Chinese system, no doubt reflecting the cultural norms and strong leadership embedded in its society. The Chinese economy and society is changing fast and with that there may be a move away from such norms. Consequently, it is suggested that the new Nuclear Safety Law should embrace IAEA GSR Part 1 Requirement 6.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 6: Compliance with regulations and responsibility for safety states that: "***The government shall stipulate that compliance with regulations and requirements established or adopted by the regulatory body does not relieve the person or organization responsible for a facility or an activity of its prime responsibility for safety"*
S4	**Suggestion: The new Law on Nuclear Safety should include a clear commitment for the maintenance of the prime responsibility for safety in line with GSR Part 1 Requirement 6.**

1.7 COORDINATION OF DIFFERENT AUTHORITIES WITH RESPONSIBILITIES FOR SAFETY WITHIN THE REGULATORY FRAMEWORK

In addition to the MEP (NNSA) there are several government administrations who have responsibilities for safety such as regulatory control of some radioactive sources (e.g. categories II–IV), radiation protection, etc.

As well as the MEP (NNSA) there are environmental protection agencies under the provincial governments of the People's Republic of China. Additionally, the Ministry of health and the Health Departments of the provincial governments (DoH) have responsibilities for the control of radiation sources used in the medical sector and the protection of occupationally exposed workers. For the control of import and export of radiation sources, the Ministry of Commerce and the Customs are involved as well. However their role is not related to regulating safety. For the security of radioactive sources, the Ministry of Public Security is involved.

As well, it was observed that there are provisions in the Regulations on Safety and Protection of Radioactive isotopes and Radiation-emitting Devices for the effective coordination of the respective regulatory function between MEP (NNSA) and the provincial EPB, so that undue duplication and conflicting requirements being placed on the authorized parties are avoided. The regulatory requirements apply and are applied consistently between MEP (NNSA) and the provincial EPB. The fact that the relevant regulations are issued by the State Council, contribute to the consistent application. Another important factor is that the provincial EPBs follow MEP (NNSA) guidance in their regulatory functions. MEP (NNSA) supervises performance of the regulatory functions of the provincial EPB through annual supervision in their headquarters as well as random inspections to selected facilities.

However, the IRRS Review Team observed that coordination between the provincial EPBs should be enhanced, and in other areas while the law may imply coordination in practice, the IRRS Review Team identified issues that have a potential of duplication, gaps and/or conflicts between the role of MEP (NNSA) and provincial EPB on one side, and, on the other side, MOH and the provincial DoH, namely:

- MEP (NNSA) and local EPA require information on occupational dose monitoring in the licensing process, monitor compliance with the related requirements during inspections and keeps a registry

of the occupational doses. MOH also establishes and enforces requirements for occupational exposure control and maintains a registry thereof;

- The IRRS Review Team was informed that MEP (NNSA) sets investigations levels for occupational doses which may differ from those adopted by MOH. This could lead to conflicting interpretation and regulatory enforcement;
- Prior to construction of a facility or conducting an activity, an environmental impact assessment is required by the Regulations on Safety and Protection of Radioactive isotopes and Radiation-emitting Devices. Additionally, for medical facilities, a radiation hygiene review is requested by MOH rule no. 46 (chapter III). The Regulation for Radiological Diagnosis and Treatment to inform the licence issued by the DoH. It seems that the scope of the environmental impact assessment and the radiation hygiene review overlap to certain extent, raising potential for duplication and, eventually, conflicting evaluation where these two documents address identical matters;
- The responsibility for the oversight of radiation protection in nuclear installations is not clearly assigned between governmental organizations. The MEP (NNSA) is the main inspecting authority for nuclear safety issues, while the radiation protection issues should be inspected by the Ministry of Health. The coordination of these two areas seems to be weak and not arranged systematically; and
- The application of the optimization (ALARA) concept did not appear to be adequately covered by any of the relevant parts of the regulatory system in various stages of nuclear facilities life cycles.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 7 states that "Coordination of different authorities with responsibilities for safety within the regulatory framework for safety states that** *"Where several authorities have responsibilities for safety within the regulatory framework for safety, the government shall make provision for the effective coordination of their regulatory functions, to avoid any omissions or undue duplication and to avoid conflicting requirements being placed on authorized parties."* **(Requirement 2 is also relevant)**
R7	**Recommendation: The regulatory authorities should establish mechanisms for the effective coordination of the regulatory functions on occupational radiation protection, including ALARA applications, amongst MOH, provincial DoH, MEP and provincial EPB to ensure complete and clear coverage and coordination.**

1.8 PROVISION FOR THE DECOMMISSIONING OF FACILITIES AND THE MANAGEMENT OF RADIOACTIVE WASTE AND OF SPENT FUEL

National Law on the Prevention and Control of Radioactive Pollution

The national law, "People's Republic of China Law on the Prevention and Control of Radioactive Pollution (2003)", provides the legislative basis for the activities needed for the safe management of radioactive waste and decommissioning of nuclear installations. The law also provides the legislative basis for the management of "uranium (thorium) and other radioactive mines".

The law provides a clear definition for radioactive waste; however, spent nuclear fuel is never mentioned explicitly in the law. It was explained that the law does not apply to spent nuclear fuel unless the spent nuclear fuel has been declared explicitly to be radioactive waste.

The law requires that a national plan be developed to address the management of all radioactive waste.

Management of radioactive waste

Radioactive waste is defined in the Law on the Prevention and Control of Radioactive Pollution as "predicted non-used discarded waste that contains, or is contaminated with, radionuclides at concentrations or activities greater than clearance level as established by the State".

An important part of the management of radioactive waste is the operation of storage facilities, and China has 31 provincial storage facilities and one national facility for storage of certain disused sealed radioactive sources. These facilities are licensed and are inspected by MEP (NNSA). These facilities are operated by the provincial environmental protection agencies. The Law on the Prevention and Control of Radioactive Pollution is applicable to all facilities and activities related to radioactive pollution, however the IRRS Review Team noted that the Law does not explicitly define storage facilities as nuclear installations (only facilities for treatment and disposal of radioactive waste are explicitly mentioned).

Two near surface disposal facilities for low and intermediate level waste are in operation and a third is under construction. The national policy is to establish five regional near surface disposal facilities. Waste generated by the nuclear power plants as well as waste stored in the provincial storage facilities will be disposed of in the near surface disposal facilities.

In summary, China will operate five disposal facilities for low and intermediate level waste and one deep geological repository for high level waste. For several reasons it is suggested that one agency is established for the implementation of waste disposal:

- A national agency is in a better position to introduce standardization of products and services (e.g., waste package designs, engineering services and safety assessment);
- Coordinated and cost-effective research and development would be facilitated;
- Siting, construction, operation and closure of repositories would be standardized; and
- A single voice, representing the waste producers, would communicate with the government.

The major waste producers (i.e. the owners of the nuclear power plants) should take the lead in establishing such an agency. The establishment of one agency would also contribute to regulatory efficiency and consequently better regulatory decisions.

Management of spent nuclear fuel

According to the Law on the Prevention and Control of Radioactive Pollution high level solid radioactive waste shall be disposed of in a centralized deep geological repository. The repository will primarily contain high level waste from the reprocessing of spent nuclear fuel. CAEA and MEP (NNSA) are jointly preparing a plan for the development of the repository. Some research and siting activities are currently carried out by CAEA.

Spent nuclear fuel from nuclear reactors is mostly stored on site. Spent nuclear fuel from new nuclear power plants will be stored for a period of several years on site and then transported to the reprocessing plant.

The policy foundation for the long-term management of spent nuclear fuel was established by the 1984 decision of the State Council to implement a closed nuclear fuel cycle. This policy has since been reaffirmed in the Medium and Long-Term Development Programme of Nuclear Power for 2005 – 2020.

Decommissioning of facilities

So far there is no large nuclear installation in the decommissioning phase. However only 3-4 research reactors are in usual power operation, the rest of the devices are rarely put into power operation. As fuel is still the reactors they are considered to be operational.

The Law on the Prevention and Control of Radioactive Pollution requires all nuclear installations to have decommissioning plans. Nuclear power plants in operation or under construction have decommissioning plans. However, many other existing nuclear installations do not have such plans in place. The IRRS Review Team noted that there is a lack of regulations and regulatory guidance for decommissioning.

Once the decommissioning is completed the licensee is released from its responsibilities. The licensee has to submit a comprehensive monitoring report to the regulator.

Remediation of sites, uranium mining and naturally occurring radioactive material **(NORM)**

MEP (NNSA) also regulates remediation of contaminated sites, uranium (thorium) mining and milling and management of NORM. All of these activities require regulations and regulatory guidance. MEP (NNSA) activities pertaining to remediation, uranium mining and milling and NORM waste were reviewed explored during this IRRS mission owing to time constraints.

Comprehensive national policy and strategy

The national policy and strategy for the safe management of radioactive waste and spent nuclear fuel and for decommissioning of nuclear installations is not described in any single document. In addition to providing a basis for regulators and implementing organizations as well as policy makers, a comprehensive policy and strategy would be useful when estimating the costs associated with waste management, including the decommissioning of nuclear installations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 1: National policy and strategy for safety states that** ***"****The government shall establish a national policy and strategy for safety, the implementation of which shall be subject to a graded approach in accordance with national circumstances and with the radiation risks associated with facilities and activities, to achieve the fundamental safety objective and to apply the fundamental safety principles established in the Safety Fundamentals".*
(2)	**BASIS: GSR Part 5 - Requirement 2: National policy and strategy on radioactive waste management states that** *"To ensure the effective management and control of radioactive waste, the government shall ensure that a national policy and a strategy for radioactive waste management are established. The policy and strategy shall be appropriate for the nature and the amount of the radioactive waste in the State, shall indicate the regulatory control required, and shall consider relevant societal factors. The policy and strategy shall be compatible with the fundamental safety principles [2] and with international instruments, conventions and codes that have been ratified by the State. The national policy and strategy shall form the basis for decision making with respect to the management of radioactive waste. (See Ref. [5].)"*
R8	**Recommendation: The government should establish a comprehensive national policy and strategy for the management of radioactive waste and spent nuclear fuel.**
(1)	**BASIS: SSR-5 (DS354) - Requirement 3: Responsibilities of the operator states that** *"The operator of a disposal facility for radioactive waste shall be responsible for its safety. The operator shall carry out safety assessment and develop a safety case, and shall carry out all the necessary activities for site selection and evaluation, design, construction, operation, closure and, if necessary, surveys after closure, in accordance with national strategy, in compliance with the regulatory requirements and within the legal and regulatory infrastructure."*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
S5	**Suggestion: The government should establish one agency responsible for the implementation of the national strategy for disposal of radioactive waste.**
(1)	**BASIS: GSR- Part 1 - Requirement 2: Establishment of a framework for safety states that "***The government shall establish and maintain an appropriate governmental, legal and regulatory framework for safety within which responsibilities are clearly allocated."*
(2)	**BASIS: GSR Part 5 §1.12 states that** "*This Safety Requirements publication applies to the predisposal management of radioactive waste of all types and covers all the steps in its management from its generation up to its disposal, including its processing (pre-treatment, treatment and conditioning), storage and transport. Such waste may arise from the commissioning, operation and decommissioning of nuclear facilities; the use of radionuclides in medicine, industry, agriculture, research and education; the processing of materials that contain naturally occurring radionuclides; and the remediation of contaminated areas."*
(3)	**BASIS: GSR Part 5 §1.13 states that** "*This publication establishes the safety requirements that apply to all facilities and activities that are involved in the management of radioactive waste before disposal."*
S6	**Suggestion: When regulations or the law on prevention and control of radioactive pollution are amended, it should be made explicit that storage facilities for radioactive waste are defined as nuclear installations.**

1.9 COMPETENCE FOR SAFETY

The State policy given in the Long Term Nuclear Power Development Plan for 2005-2020 approved by the State Council takes into account the need for provision of human resources as well as enhancement of research and development for a safe and sustainable nuclear power programme. It emphasizes the need for the availability of sufficient number of suitably qualified and experienced staff to achieve the goals as laid down in the policy. In this context, the policy stresses that educational institutions and research should seize the opportunity to train professionals for safety, design, construction, manufacturing, commissioning and operations of nuclear power plants. The policy especially mentions that Tsinghua University, Shanghai Jiaotong University and Xian Jiaotong University to focus on competency building for nuclear power development programme.

The IRRS Review Team has noted considerable efforts of MEP (NNSA) and other institutions involved in maintaining proper number and qualification of staff supporting regulatory activities. At the time of the mission, the total staff of this department was about 59, while the six regional offices had a staff of about 200 and the Nuclear Safety Center which is the MEP (NNSA) dedicated Technical Support Organization (TSO) had about 230 staff. All this staff is providing regulatory oversight to 11 operating and 28 Nuclear Power Plants (NNPs) under construction and research reactors, fuel cycle facilities, radioactive sources, environmental radiological monitoring and nuclear safety equipment, etc.

Discussion with staff and management of MEP (NNSA) and NSC has indicated that this number is not sufficient to effectively perform its statutory functions especially taking into account the rapid nuclear power development programme of China. The government is aware of this limitation and has already committed itself to increase the technical staff of MEP (NNSA) to altogether 1000 in 2 to 3 years. Staff number of regional offices is to grow to 331, while NSC staff number should increase from current 230 to 600. It is also foreseen to grow the total staff number to 2000 by the year 2020. How quickly MEP (NNSA) will be able to recruit such a significant number of staff, especially senior experienced staff, is questionable considering factors such as the disparity in compensation between the nuclear industry and

state administration organizations e.g. MEP (NNSA). In response to this challenge the MEP (NNSA) has developed a strategy for hiring and training young inexperienced staff from universities and providing them with a robust training programme to build competency. In addition MEP (NNSA) has arrangements with the industry to have its staff members occasionally trained by working a certain period for the industry.

The commitment of the government to increase the number of staff regulating nuclear safety of the expanding nuclear power programme can be considered as a very positive step. However, the IRRS mission has observed that there is no system in place to regularly monitor sufficiency and competence of available human resources. A national plan on human resources management could improve this situation. Such a plan on human resources could be integrated in the national nuclear power programme strategic plan.

IRRS Review Team has noted the interesting practice of qualification/registration of nuclear safety engineers by the MEP (NNSA). Such qualification/registration is a prerequisite for the employment in the organizations dealing with the nuclear safety. IRRS Review Team also noted the system supporting the on-the-job training of MEP (NNSA) personnel by supporting postgraduate studies at universities.

IRRS Review Team has noted the practice by MEP (NNSA) to recommend some universities and scientific research institutions as the specialized training organizations for certain professional areas important for radiation safety. MEP (NNSA) has provided help with assistance from IAEA to those organizations to build up the competence of teachers and prepare unified training materials and set up a test pool. It would be beneficial to expand such a practice also to other areas.

In the area of the regulatory control of radiation sources, the MEP (NNSA) and other involved authorities have adequate number of qualified staff. The Regulations on Safety and Protection of Radioactive isotopes and Radiation-emitting Devices (Decree no. 449 of the State Council, 2005) require inspectors to have certain qualifications without further details. MEP (NNSA) has applied certain elements of the qualification criteria of nuclear safety inspectors to the radiation sources inspectors. Those inspectors are subject to a formal certification after passing relevant examination. There is also a regular refreshment training in addition to special training, e.g. when new regulations, guides or related administrative documents are issued. However, inspectors from other involved authorities, e.g. provincial EPB, may not be subject to similar approach. The IRRS Review Team was informed that the provincial environmental monitoring regulations would specify the respective EPA's inspectors' qualifications.

The IRRS Review Team was informed that the draft document Implementation Rule for Safety and Protection management of radioisotopes and radiation-emitting devices, which is being prepared by MEP, includes detailed provisions for the academic, qualifications of relevant inspectors, initial and refreshment training programmes, and the minimal working experience in radiation safety. Such a document could contribute towards the harmonization of practices throughout the country and all organizations involved.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 11: Competence for safety states that** "*The government shall make provision for building and maintaining the competence of all parties having responsibilities in relation to the safety of facilities and activities.*"
S7	**Suggestion: The government should develop the national human resources development plan as an integral part of the five years national nuclear power programme strategic plan.**
S8	**Suggestion: The MEP (NNSA) may consider expanding the system of recommendations for training organizations to all professional areas relevant to nuclear safety.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
GP3	**Good Practice: The MEP (NNSA) recommendations for universities and other training of engineers in some professional areas is very useful.**
GP4	**Good Practice: The qualification and registration of nuclear safety engineers in China is considered a good practice**

2. GLOBAL NUCLEAR SAFETY REGIME

2.1. INTERNATIONAL OBLIGATIONS AND ARRANGEMENTS FOR COOPERATION

The People's Republic of China has signed and ratified the following international conventions;

- Convention on Nuclear Safety;
- Convention on Early Notification;
- Convention on Assistance in case of Nuclear Accident and Radiological Emergencies;
- Joint Convention on the Management of Spent Fuel and the Management of Radioactive Waste; and
- Convention on Physical Protection of Nuclear Material.

It also adheres to the Code of Conduction of Sources and Research Reactor.

CAEA is the national coordinating channel to the IAEA and responsible for some of the Conventions such as Physical Protection, Early Notification of a Nuclear Accident, etc. The MEP (NNSA) is responsible for the IAEA Conventions related to nuclear and radiation safety, e.g. Convention on Nuclear Safety, Joint Convention on the Management of Spent Fuel and the Management of Radioactive Waste.

MEP (NNSA) has established bilateral cooperation with foreign nuclear regulatory bodies of twelve countries, including, Brazil, Canada, France, Germany, Japan, Pakistan, Russian Federation, South Korea, Spain, UK, Ukraine and the USA. MEP (NNSA) also participates in some OECD-NEA activities like Multinational Design Evaluation Programme (MDEP) although not being a member or observer of OECD-NEA. MEP (NNSA) actively participates in IAEA Safety Standards Committees and IAEA peer review missions too. However, because of constraints on MEP (NNSA) international cooperation resources there are limitations on the MEP (NNSA) staff to actively participate in international activities. MEP (NNSA) and PRC should increase participation in specialized international workgroups on particular technical issues, leading to the development of standards and exchange of practices in the nuclear safety area. There is a need to ensure a sufficient budget is provided.

The IRRS Review Team has also noted that some administrative restrictions related to travels of staff to foreign countries are in place. Limited communication channels with the international nuclear fora is seen as a challenge especially given the nature of some of the new designs of nuclear power plants which originate from abroad. The more intensive exchange of operating experiences could substantially benefit nuclear safety in China as well as other countries by learning from each other. It is also a major aspect of the Chinese strategic approach to ensuring the safe development of nuclear power.

The national liaison with the IAEA is done through the CAEA. This may have influence to the efficiency and effectiveness, as well as independence of the communication related to the nuclear safety regulatory issues. The direct line of communication/interaction from MEP (NNSA) to the IAEA could improve this situation.

The PRC is committed to adhere to internationally recognized standards and relevant conventions; however, there is room for further considerable enhancement of this cooperation on wider and more detailed technical levels.

The cooperation should involve more interaction with IAEA, other regulatory bodies and international organizations, such as the Asian Nuclear Safety Network (ANSN)), etc. to have a wider range of interactions at all levels.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR-Part 1 – Requirement 14: International obligations and arrangements for international cooperation states that** *"The government shall fulfil its respective international obligations, participate in the relevant international arrangements, including international peer reviews, and promote international cooperation to enhance safety globally."*
R9	**Recommendation: MEP (NNSA) should be provided with adequate resources and flexibility for international cooperation, especially taking into account the nature of some of the new designs of nuclear power plants which originate from abroad.**
S9	**Suggestion : MEP (NNSA) should have its own line of communication/interaction with the IAEA.**

2.2. SHARING OF OPERATING EXPERIENCE AND REGULATORY EXPERIENCE

MEP (NNSA) has made arrangements for receiving information on operating and regulatory experience bilaterally with some other States (e.g. France, Pakistan, etc.). The operating and regulatory experience and lesson learned is shared during the annual meetings held under these bilateral agreements.

MEP (NNSA) participates in the Multinational Design Evaluation Programme (MDEP) and is also a part of tri-lateral regional nuclear safety cooperation agreement between China, Japan and Korea in which operating and regulatory experiences are shared. It regularly shares regulatory review experiences on AP-1000 and EPR with USNRC and ASN. MEP (NNSA) is also a member of Asian Nuclear Safety Network (ANSN) and regularly contributes in its activities.

The government of China and its relevant institutions including NEA, CAEA and in particular MEP (NNSA) recognize that active international cooperation is an integral part of enhancing nuclear safety and that multilateral, bilateral and regional cooperation and sharing of information bring tremendous benefits to the cooperating parties in enhancing nuclear safety nationally, regionally and globally. The senior management of MEP (NNSA) is committed to continue and further enhance the international cooperation, but the IRRS Review Team noticed that their ability to enhance international cooperation is severely restrained in terms of resources and administrative restrictions. MEP (NNSA) has only approximately 1.5% of its annual budget allocated for its international activities. The IRRS Review Team noticed that with the vast experience of regulating 11 operating and 28 plants under construction, MEP (NNSA) has accumulated a repository of regulatory knowledge base which is very valuable for sharing with the global nuclear safety community especially for countries embarking on new nuclear power programmes. The enhancement of the resources of MEP (NNSA) for international cooperation and sharing of regulatory experiences would be very beneficial.

The IRRS Review Team noted that the use of IAEA IRS system is limited in MEP (NNSA). More importantly MEP (NNSA) is not required to provide any input to IAEA IRS system which is the sole responsibility of CAEA. The reporting to IRS by CAEA without the input from MEP (NNSA) has the potential that safety significant issues are not covered in enough detail for efficient operating experience and regulatory experience exchange on the global level.

MEP (NNSA) should have the role of IRS coordinator. This will enable them to be fully informed of international notified events and provide a platform to get more involved in exchanging operating experience and regulatory experience with other countries.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 15: Sharing of operating experience and regulatory experience states that** *"The regulatory body shall make arrangements for analysis to be*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	carried out to identify lessons to be learned from operating experience and regulatory experience, including experience in other States, and for the dissemination of the lessons learned and their use by authorized parties, the regulatory body and other relevant authorities."
R10	**Recommendation*:* MEP (NNSA) should take over the role of national IRS coordinator, and act as the prime link into the Asian Nuclear Safety Network (ANSN).**

3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY

3.1. ORGANIZATIONAL STRUCTURE OF THE REGULATORY BODY AND ALLOCATION OF RESOURCES

The MEP (NNSA) is an independent regulatory body reporting to the State Council through the Minister of Environmental Protection (MEP).

The National Nuclear Safety Administration (NNSA) was established in 1984 and combined into the State Environmental Protection Agency (SEPA) in 1998 as the Department of Nuclear and Radiation Safety Management. In 2008, as a part of governmental restructuring, the Ministry of Environmental Protection (MEP) was formed with fourteen (14) departments. The Administrator of the NNSA is one of the five Vice Ministers of the MEP. The Department of Ecology, although not integrated in the MEP (NNSA), is also under the supervision of the VM MEP (NNSA).

The MEP (NNSA) is structured as follow:

- The Department of Nuclear and Radiation Safety Management is responsible for the overall regulatory oversight of all the nuclear installations including Nuclear Power Plants (NPPs), research reactors, nuclear fuel cycle, Category I radioactive sources and radiation generators. The current staff complement of this Department is 59;
- Six Regional Offices located at Shanghai, Shenzhen, Chengdu, Beijing, Lanzhou and Dalian are mainly responsible for inspections over nuclear infrastructures and technologies within the authorized scope. The total current staff complement of these regional offices is 200 which has been approved to increase to 331;
- The Nuclear and Radiation Safety Centre (NSC), which is the dedicated Technical Support Organization (TSO) of the MEP (NNSA), provides technical support to the Department of Nuclear and Radiation Safety and to the six regional offices. Besides NSC, four external TSO's also provide technical support to MEP (NNSA). Although NSC is directly affiliated to MEP (NNSA) and reports through its Director General to the administrator of MEP (NNSA), it is a separate legal entity. The current staff of this Centre is 230 which has been approved to increase to 600 by 2012 and has a target staff complement of 1000-1200 by 2020;
- The Department of International Cooperation is responsible for the overall nuclear safety international cooperation such as bilateral, multilateral cooperation ;
- A Chief Nuclear Safety Engineer has been appointed in the MEP (NNSA) structure reporting directly to the MEP Vice Minister. The main role of this Chief Nuclear Safety Engineer is to provide technical advice to the VM on matters of Nuclear and Radiation Safety. This person also provides some management support to the VM for the management of the six Regional Offices of NNSA and the Nuclear and Radiation Safety Centre; and
- A Nuclear Safety Advisory Commission provides technical advisory support to the VM.

General management support services such as Administrative Systems and Human Resources, Planning and Financial Services etc., are centralized in the MEP. MEP (NNSA) shares these resources with the other Departments of the Ministry of Environmental Protection.

The total manpower of MEP (NNSA) at the time of the mission was 250, which is providing regulatory oversight to 11 operating and 26 Nuclear Power Plants (NPPs) under construction, research reactors, fuel cycle facilities, radioactive sources etc. Furthermore it is expected that more applications for construction of new Nuclear Power Plants will be received by MEP (NNSA) for review at a rate of eight per year over the next 5 years. This does not include potential increase in radioactive sources and potential other nuclear fuel facilities which will also require review by MEP (NNSA).

The MEP (NNSA) conducts its regulatory oversight of nuclear installations and radiation facilities and activities mainly according to the "Regulations on the Safety Regulation for Civilian Nuclear Installations of People's Republic of China (HAF-001)" promulgated by the State Council on October 29, 1986, "Regulations on Nuclear Materials Control of People's Republic of China (HAF501)" promulgated by the State Council on 15 June 1987, and the Law of the People's Republic of China on Radioactive Pollution Prevention and Control promulgated by the State Council on 28th June 2003.

The responsibilities and main duties of the MEP (NNSA) include:

- providing regulatory oversight on nuclear safety and radiation safety;
- preparing regulation on safety of nuclear installations and radiation facilities and activities;
- responsibility for the supervision on activities for the design, manufacturing, installation, and non-destructive testing of nuclear equipment and for the safety testing of imported nuclear equipment;
- responsibility for the supervision on the control and protection of nuclear materials;
- responsibility for the regulation on nuclear technology utilization projects, the radioactive safety and environmental protection of uranium (thorium) minerals and associated radioactive minerals; and the regulation of radiation protection;
- responsibility for the regulation of the safe treatment and disposal of radioactive wastes and the supervision on environmental protection for radiation; responsibility for the supervision on prevention and control of radioactive pollution;
- responsibility for the regulation on the safe transportation of radioactive substances;
- responsibility for the emergency response of MEP, investigation and handling of nuclear and radioactive accidents; to participate in precaution against and deal with nuclear and radiation terrorist attacks;
- responsibility for the qualification management of operators of reactors and nuclear equipment technicians, etc.;
- organizing the radioactive environmental monitoring and monitoring of nuclear installations and key radioactive sources for supervision purposes; and
- responsibility for implementing international conventions related to nuclear and radioactive safety.

In conducting its regulatory activities, the NNSA uses a graded approach commensurate with the risks associated with the facilities and activities with the most significant being the regulatory control of Nuclear Power Plants. These principles are encapsulated in the various regulations (HAF's) for regulating such facilities (e.g. Nuclear Power Plants, Research Reactors, etc.).

The main duties of the technical support organizations (TSOs) include the following:

- technical review on nuclear infrastructures, nuclear safety equipment, MEP (NNSA)-licensed nuclear technology projects and uranium (thorium) facilities, as well as technical support for various administrative permits;
- technical support for regulating nuclear infrastructures, Category I radioactive sources and radiation installations;
- study and stipulation of regulations and standards on nuclear and radiation safety;
- research and development related to nuclear and radiation safety;
- offering professional training related to nuclear and radiation safety; and

- technical support to preparedness and response to nuclear and radiation emergencies.

Besides MEP (NNSA), additionally, the Ministry of health and the Health Departments of the provincial governments (DoH) have legislative responsibilities for the control of radiation sources used in the medical sector and the protection of occupationally exposed workers.

The Ministry of health and the provincial departments of Health (DoH) are responsible for controlling:

- occupational exposure in all facilities and activities;
- health surveillance of workers;
- justification and optimization of medical exposure; and
- quality assurance in medical facilities and practices.

MOH or provincial DoH conducts annual inspections to all facilities. The scope of the inspection addresses occupational health and include: individual monitoring and health surveillance of workers. Additionally, for medical facilities, the inspection includes QA programmes as specified in departmental rule no. 46 of MOH (2006).

MOH has established requirements for quality control of equipment used in medical facilities. Acceptance tests are required as part of application for authorization. Initial and annual tests, calibration and maintenance must be performed by testing institutions, which have to be accredited by MOH.

For the control of import and export of radiation sources, the Ministry of Commerce and the Customs are involved as well. However their role is not related to regulating safety. For the security of radioactive sources, the Ministry of Public Security is involved.

Within the context indicated above the IRRS Review Team has observed the following:

- The Administrator of the MEP (NNSA) is also responsible for the administration of the rather large Ecology Department that has the potential of defusing his responsibilities towards Nuclear Safety;
- Discussions with MEP (NNSA) and the NSC, related to Human Resources, have indicated that the staffing complement of MEP (NNSA), as discussed above, is not sufficient to effectively perform its statutory functions especially taking into account the current and the rapid nuclear power development programme of China. The government is aware of this limitation and has already committed to increase the technical staff of MEP (NNSA) to 1000 by 2015. The speed and readiness of MEP (NNSA) to recruit such a significant number of staff especially senior experienced staff is a challenge considering factors such as for example the disparity in compensation between the nuclear industry and state administration organizations, e.g. MEP (NNSA);
- From the organizational structure of MEP (NNSA), it is often difficult to understand the lines of responsibilities and flow of information, therefore there is room for improvement. This is especially evident in respect of the coordination of regional offices, which should have one single contact point in the headquarters; and
- The MEP (NNSA) shares general management support services such as Administrative Systems and Human Resources, Planning and Financial Services etc. with the other Departments of the Ministry of Environmental Protection which put some constraints on MEP (NNSA) flexibility, within the Policies and procedures of the MEP Department of Administrative System and Human Resources, to effectively manage its resources to discharge its regulatory responsibilities.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 16: Organizational structure of the regulatory body and allocation of resources states that** *"The regulatory body shall structure its organization and manage its resources so as to discharge its responsibilities and to perform its functions effectively; this shall be accomplished in a manner commensurate with the radiation risks associated with facilities and activities"*
R11	**Recommendation: In the circumstances of MEP (NNSA) becoming a real integrated body, to maximize regulatory effectiveness it should be organized with a clearer and more efficient line management structure where responsibilities are well defined and understood by everybody involved, ensuring that regional offices report to one coordinating body within the NNSA.**

3.2 EFFECTIVE INDEPENDENCE

As indicated in Section 1.4 above, the MEP (NNSA) is independent in terms of reporting line in the government structure**.** It is also independent from organizations promoting nuclear energy and also operating nuclear power plants. In discharging its function this independence is re-enforced to all staff in training etc.

Any application for a license is first technically reviewed by the relevant Technical Support Organization, most frequently by NSC. The results of the evaluation are then reviewed by the staff of the Department for Nuclear and Radiation Safety Management and the draft licence is prepared. Before the license is granted, the Nuclear Safety Advisory Committee, consisting of about 100 independent experts, is consulted for independent opinion on some issues. Only after their positive opinion the vice-minister signs the license.

These aspects contribute to the effective independence of MEP (NNSA) in the performance of regulatory functions.

3.3. STAFFING AND COMPETENCE OF THE REGULATORY BODY

MEP (NNSA) has developed training programme including implementation plans for training of its staff. The objective of this programme is to ensure that they can discharge their duty effectively as required and includes orientation and on-the-job training. MEP (NNSA) has also formulated regulations relevant to the training, qualification and examination of nuclear safety inspectors in order to ensure that the quality of nuclear safety inspection is excellent. In accordance with Rules for the Implementation of Regulation on the Safety Regulation of Civil Nuclear Installations of PRC, a nuclear safety inspector should meet the following major requirements:

- College education or above, or equivalent;
- Over 5 years of engineering experience or over 3 years of nuclear safety management experience; capable of performing nuclear safety inspection duties, making correct judgments and drafting acceptable reports;
- Familiarity with national laws and regulations on nuclear safety and exemplary abidance by the same; and
- Integrity, impartiality, meticulousness and modesty in discharging duties.

MEP (NNSA) selects candidates meeting the aforesaid requirements and provides them with training programmes and examinations, as needed by the inspection work. Examinations comprise written and oral

examinations. Those who pass the examinations are given a Nuclear Safety Inspector Identity Card issued by MEP (NNSA) without which no one can conduct a nuclear safety inspection under the relevant law.

MEP (NNSA) have started a joint programme with seven universities/research institutes to start training programmes on radiation safety protection for administrators involved in managing radioactive source safety.

MEP (NNSA) has also an agreement with Tsinghua University for conducting Masters in Radiation Protection and Environmental Protection jointly for training and qualifications of its staff as well as other students. Furthermore, the Chinese government is actively seeking support of IAEA for training of senior nuclear safety inspectors for China.

However, in its self-assessment report MEP (NNSA) has clearly identified that there is an urgent need to intensify technical competency required for nuclear safety regulation and to increase and upgrade technical capabilities. The focus of competency development should be on nuclear safety research and development, safety related analysis, quality assurance for nuclear safety equipment, radiation monitoring and nuclear accidents emergency response. In its action plan MEP (NNSA) has identified that urgent measures are needed to fill the competency gaps in performing independent audit calculations as apart of safety assessment and for this purpose an amount of over 1 billion RMB has already been allocated. The plan includes building capability and capacity for safety audit calculations and acquiring independent validated computer codes and establishment of a new equipment testing laboratory. The government of PRC has already committed to increase MEP (NNSA) strength to 1000 by 2015. The MEP (NNSA) has a well thought strategy for training of new staff members but MEP (NNSA) considers that recruiting such a large number of staff` in an expanding nuclear power industry would be a challenge especially because of the remuneration disparity between the industry and MEP (NNSA). Additionally, the adopted approach is not based on systematic approach to training (SAT) and in this regard a systematic training need assessment has not been performed by MEP (NNSA) to identify the competency gaps.

In order to make recruitment of new staff systematic and in line with the requirements based on the nuclear regulatory duties of regulatory bodies, compilation and application of a Competence Matrix would be beneficial. Furthermore, the application of the Systematic Approach to Training (SAT) as recommended by IAEA, would effectively contribute to the proper training of the staff (both initial training and retraining).

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GS R Part 1 - Requirement 18: Staffing and competence of the regulatory body states that** *"A process shall be established to develop and maintain the necessary competence and skills of the regulatory body, as an element of knowledge management. This process shall include the development of a specific training programme on the basis of an analysis of the necessary competence and skills."*
R12	**Recommendation: MEP (NNSA) should develop and implement an integrated human resource management programme, in particular technical competence including knowledge management and systematic approach to training, commensurate with the needs to fulfil their regulatory responsibilities taking into account the current and the rapid nuclear power development programme of China. The ability for MEP (NNSA) to address this recommendation would be facilitated by the government addressing recommendations 4 and 5.**

3.4. LIAISON WITH ADVISORY BODIES AND SUPPORT ORGANIZATIONS

Article 5 of the Regulations HAF 500 (001) makes provision for the NNSA to set up a Nuclear Safety Advisory Committee that will assist to establish nuclear safety regulations and plan for the development of safety techniques and participate in the work of nuclear safety assessment and surveillance.

Such Advisory Committee, comprising approximately 100 members made up from experts from relevant academic institutions, nuclear power plants, the NNSA etc. has been set up. The VM of MEP (NNSA) is the chairman of this Committee**.** It was noted that when discussions about a particular facility are held then the experts associated from that facility are excluded.

MEP (NNSA) has its own Technical Support Center called the Nuclear and Radiation Safety Centre (NSC). Besides NSC the following four technical support organization also provides technical support to MEP (NNSA):

- Environmental Radiation Monitoring Station in Zhejiang Province;
- Nuclear Installations Safety and Reliability Centre of Mechanical Institute;
- the Nuclear Safety Centre in Suzhou; and
- Beijing Review Centre of Nuclear Safety.

The Nuclear and Radiation Safety Centre (NSC) provides dedicated technical support services to the headquarter and regional office of MEP (NNSA). The liaison arrangements are well established in practice with other technical support organizations not owned by MEP (NNSA), but are not formally documented and so there is a potential of conflict of interest which needs to be addressed.

NSC uses subcontractors from organizations that have some linkage with operating organizations**.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 20: Liaison with advisory bodies and support organizations states that** *"The regulatory body shall obtain technical or other expert professional advice or services as necessary in support of its regulatory functions, but this shall not relieve the regulatory body of its assigned responsibilities."*
(2)	**BASIS: GSR Part 1 Requirement 20: Liaison with advisory bodies and support organizations §4.20 states that** *"Arrangements shall be made to ensure that there is no conflict of interest for those organizations who provide the regulatory body with advice or services. If this is not possible domestically, then the necessary advice or assistance shall be sought from organizations in other States or, as and where appropriate, from international organizations which have no such conflicts of interest."*
(3)	**BASIS: GSR Part 1 Requirement 20: Liaison with advisory bodies and support organizations §4.21 states that** *"If the necessary advice or assistance can be obtained only from organizations whose interests potentially conflict with those of the regulatory body, the seeking of this advice or assistance shall be monitored, and the advice given shall be carefully assessed for conflicts of interest."*
R13	**Recommendation: MEP (NNSA) should make formal arrangement with Technical Support Organizations that they are using to ensure that there is no conflict of interest. Also the potential for conflict of interest within the subcontractors used by the TSOs should be periodically assessed by NNSA.**

3.5 LIAISON BETWEEN THE REGULATORY BODY AND AUTHORIZED PARTIES

There is both formal and informal mechanisms of communication with authorized parties on all safety issues at working level as well as the level of senior management. Top level meetings at corporate level is held once a year with NPP operating organizations managements to discuss management of safety and safety culture. These meetings are open, frank and helps in fostering mutual understanding and regulatory requirements and decisions are justified, if required. There is adequate and effective interaction between the MEP (NNSA) and nuclear power plants at various levels of the organizations. These arrangements are however not in place for some of the other authorised facilities.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 20: Liaison with advisory bodies and support organizations states that** *"The regulatory body shall obtain technical or other expert professional advice or services as necessary in support of its regulatory functions, but this shall not relieve the regulatory body of its assigned responsibilities."*
S10	**Suggestion: The MEP (NNSA) should continue regulatory liaison arrangements with authorized facilities.**

3.6 STABILITY AND CONSISTENCY OF REGULATORY CONTROL

The regulatory processes e.g. authorisations, review and assessment etc. are documented in internal procedures. The regulatory process is formally based on policies, principles and associated criteria that follow specified procedures. The process has elements of appeal to regulatory decisions and so far there has been no request for review of regulatory decisions regarding nuclear installations but for radiation facilities and activities there have been appeals in some cases. MEP (NNSA) prepares safety evaluation reports which are the basis for justifying regulatory decisions, when required. The objectives, principles and associated criteria for safety for review and assessment and inspection and enforcement are informed to the applicants.

As an example the review and assessment process of safety submissions received from the operators are subjected to a comprehensive peer review process before recommendations are submitted for approved to the VM.

3.7. SAFETY RELATED RECORDS

MEP (NNSA) has made provision for establishing, maintaining and retrieving of records.

However taking into account the current and future nuclear programme, and related submissions to be made to and reviewed by the MEP (NNSA), it is expected that the number of safety related records to be kept by the MEP (NNSA) will increase accordingly. The retrieval of records in an efficient manner is an important parameter in terms of informing the review of safety submissions by the MEP (NNSA). As the number of records significantly increases the ability of effectively retrieving records will become more difficult thus presenting the MEP (NNSA) with a challenge related to the current arrangements for long-term retrievable storage of records.

The Regulations make provision for record keeping by the licensees of nuclear facilities in line with the IAEA requirements.

MEP (NNSA) has recently established a new system for establishing and maintaining registers of radioactive sources and radiation-emitting equipment, records of occupational doses, records relating to the safety of facilities and activities and records of radiation events. Data that was previously stored in RAIS system has been transferred to the new system. The Provincial Environmental Protection Administration Bureau (provincial EPB) have access to the data that are relevant to their provinces. Users

of radiation sources have also access to their data. Other governmental authorities such as MOH and Ministry of Public Security, however, do not have access to the system.

The IRRS Review Team was advised that there are no systematic mechanisms for information exchange of radiation safety related records between MEP (NNSA) and MOH.

It appears that dissemination of regulatory data to relevant authorities is not done in an automatic manner. It's up to the relevant authority to access the system and retrieve the information.

With respect to occupational doses, the IRRS Review Team was concerned about potential causes of inconsistencies between the data maintained in MOH and the data maintained in MEP (NNSA). For example, the way the information is collected and recorded may give rise to human errors.

In appears to the IRRS Review Team that information management, such as data analysis and alerting mechanisms, could be improved so as to enhance regulatory performance.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 35: Safety related records states that** *"The regulatory body shall make provision for establishing, maintaining and retrieving adequate records relating to the safety of facilities and activities."*
R14	**Recommendation: The authorities involved in the regulatory body should enhance their information management to ensure proper information recording, analysing and dissemination to the relevant stakeholders (including the international organization) in a timely manner.**
S11	**Suggestion: MEP (NNSA) should consider strengthening its arrangements for document management, record keeping and long-term retrievable storage in accordance with the management system.**

3.8. COMMUNICATION AND CONSULTATION WITH INTERESTED PARTIES

MEP (NNSA) proactively participates in public campaigns and debates to promote nuclear safety and helps understanding of the public and builds public opinion about enhancing safety keeping in view the rapid expansion of nuclear power programme in China.

MEP (NNSA) is also participating in the government publicity campaign for encouraging the public to participate actively in the cause of nuclear safety and thereby also understanding public right to know, and participate in the regulatory process. A catalogue of Information Publicity of the Ministry of Environmental Protection was formally issued in 2008, which contained basic information, policies, and regulations on nuclear and radiation safety. The catalogue will be amended from time to time with the development of nuclear safety infrastructure in China.

Currently, MEP (NNSA) is working towards improving government publicity drive to enhance public trust in nuclear safety through regular interaction with the public and providing them with access to relevant documents.

MEP (NNSA) is working towards promoting public participation in the environmental impact assessment of nuclear power plants.

The MEP (NNSA) in its self-assessment report has clearly indicated its commitment for devoting all resources possible for enhancing public participations in regulatory process and thereby enhancing public trust in its regulatory activities for ensuring nuclear safety in the country. To fulfil this commitment MEP (NNSA) will ensure public participation in the environmental impact assessment at all stages of siting, design, construction, commissioning and operations.

The process will ensure that owner/operators of plants provide information to the public and take account their concern. We note that MEP (NNSA) has made extensive efforts to involve public participation in its regulatory processes.

MEP (NNSA) also regularly meets with the local authorities around nuclear facilities. A yearly environment day is organized by the government which include communication related to the nuclear industry. Public information/communication is also done via the MEP (NNSA) website. Public around nuclear installations are informed about nuclear emergency arrangements by the licensees.

The IRRS Review Team notes that the regulatory body wishes to further enhance public trust but does not appear to have routine meetings with the public and officials at local level. General public information/education about the regulator is also seen as a challenge to MEP (NNSA) which could be strengthened by enhancing interaction with the public.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR-Part 1 Requirement 36: Communication and consultation with interested parties states that** "*The regulatory body shall promote the establishment of appropriate means of informing and consulting interested parties and the public about the possible radiation risks associated with facilities and activities, and about the processes and decisions of the regulatory body. The regulatory body shall establish, either directly or through authorized parties, provision for effective mechanisms of communication and shall hold meetings for informing interested parties and the public and to inform the decision making process.*"
S12	**Suggestion: MEP (NNSA) should consider holding meetings with the residents and representatives of the public of the areas around the operating facilities to explain their work and decisions.**

4. MANAGEMENT SYSTEM OF THE REGULATORY BODY

Description of the Management System of MEP (NNSA)

The main elements formalizing the organizational management of the MEP (NNSA) include:

(i) The top level notification of the establishment of the MEP (NNSA) is documented in the State Council "Notification on the establishment of Agencies under State Council administrated by Ministries". This document describes the overall mission and responsibilities of MEP (NNSA), its overall structure and staffing;

(ii) The MEP (NNSA) develops a 5 years strategic plan describing its activities. A 20 years nuclear strategic plan is also developed at national level with input from MEP (NNSA) approved by the State Council;

(iii) The next level in the hierarchy of the management system consists of internal Departmental Rules for the implementation of Departmental and Divisions functions and responsibilities; and

(iv) The next level consists of procedures documenting the working processes of the MEP (NNSA) e.g. authorization, inspection, review and assessment.

The MEP (NNSA) management system is an integral part of the overall MEP Management system architecture. General management support services such as Administrative Systems and Human Resources, Planning and Financial Services etc. are centralized in the MEP and MEP (NNSA) shares those with the other Departments of the Ministry of Environmental Protection and as such has no control related to the development and implementation of the related processes.

MEP (NNSA) has made progress in establishing, implementing and documenting some of its activities, especially in defining functions, tasks and authorities of various department of MEP (NNSA) as documented in the Internal Management Procedure of MEP (NNSA). These are documented in separate procedures and have not been fully integrated into a management system consolidating all its processes considering all the requirements of the IAEA GS-R-3. The specific observations are provided below.

4.1. MANAGEMENT SYSTEM

Safety Culture: GS-R-3 requires that the management system be used to promote and support a strong safety culture. In MEP (NNSA), safety culture is considered to be an important issue and promoting safety culture to be an essential element of a robust safety and security infrastructure. Although the MEP (NNSA) reported to initiate the fostering of safety culture within its organization, currently there is no formal documented mechanism in the management system processes to promote safety culture in MEP (NNSA).

Graded Approach: GS-R-3 requires that the application of the management system is to be graded, giving due consideration to the potential hazard and consequences in an activity or facility. MEP (NNSA) application of management system requirement is not clearly graded but grading is applied to some extent in developing the human resource plan. Each division has its own development plan with clearly stated functions and responsibilities.

Documentation of the management system: GS-R-3 requires that the documentation of the management system include the policy statements of the organization, a description of the management system, the organizational structure, the responsibilities and accountabilities of those managing and performing work and a description of the processes of the work carried out by the organization. GS-R-3 requires that the documentation be understandable to those who use it and that it be made available at the point of use. Documents exist that describe the organizational structure of MEP (NNSA), the functions of each division, the roles and responsibilities of each unit, procedures for the development of regulations and guides, the authorization process, and guidelines for inspection and enforcement. These are documented

in separate procedures and have not been integrated into a management system consolidating all its processes which will consider all the requirements of the IAEA GS-R-3.

4.2. MANAGEMENT RESPONSIBILITY

There is an indication of management commitments to establish a management system, but work on formally developing an integrated management system has not commenced, and resources to establish the management system have not been provided. However, senior management through their individual values and behaviour support implementation of management system and act as role models. MEP (NNSA) has no mechanism to assess whether stakeholder satisfaction is addressed.

MEP (NNSA) develops its work plan for each year. Senior management of MEP (NNSA) participate in an annual review of existing activities for each Division and staff member and those planned for the forthcoming year. Based on that plan, the regulatory body asks the Minister of Environmental Protection for the needed human and financial resources. MEP (NNSA) also prepares specific plans to carry out particular projects and request the necessary resources for these activities.

Since an integrated documented management system does not exist so there was little evidence of demonstration of management commitment to continual improvement of management system. Background interviews revealed that there has been limited initiative to develop individual and institutional values and defining behavioural expectation for staff of regulatory body. However, senior management tries to install a culture of professionalism and efficiency.

MEP (NNSA) has not formally documented its internal or external stakeholders and therefore any effort to assess and measure their expectation is also missing.

4.3. RESOURCE MANAGEMENT

GS-R-3 requires that senior management determine the amount of resources necessary, and provide the resources to carry out the activities of the organization, or to establish, implement, assess and continually improve the management system. [Note: Resources includes staff, infrastructure, office and laboratories, equipment, and financial resources]. MEP (NNSA) did not provide evidence that it has determined what resources are necessary to carry out all of its activities, or to establish the management system.

GS-R-3 requires that senior management determine the competence requirements for staff at all levels, and to provide training to achieve the required level of competence. GS-R-3 also requires that senior management ensure that individuals are competent to perform their assigned work, and that they understand the consequences for safety for their activities. MEP (NNSA) did not provide evidence that it has determined the competence requirements for staff at all levels through a systematic training needs application (TNA).

GS-R-3 requires that senior management is to determine, provide and maintain infrastructure and working environment for the requirements to be met. MEP (NNSA) did not provide evidence that it has determined the physical resources that are required to carry out its activities.

There was no documented evidence about the level of resources, including staff numbers, office and laboratory space, and working equipment, required by MEP (NNSA) to carry out its activities and responsibilities although the NSC has some such plan.

The competence requirements for staff at all levels and their training programme were not available. There was no formal mechanism for evaluation of effectiveness of training programmes.

4.4. PROCESS IMPLEMENTATION

The core processes of MEP (NNSA) include the development of regulation and guides, authorization, review and assessment, inspection and enforcement, and the provision of some technical services, but they are not fully documented. Other processes of MEP (NNSA) include management processes (e.g.

business planning, performance management) and supporting processes (e.g. human resources, purchasing).

Some elements on procedures for the core processes have been developed, such as for authorization, review and assessment, and inspection of the use of radiation sources in industry and medical facilities, and research reactors, but they are general and not facility specific.

While some elements of the processes of MEP (NNSA) are documented, others are not. General management support services such as Administrative Systems and Human Resources, Planning and Financial Services etc. are centralized in the MEP and MEP (NNSA) shares those with the other Departments of the Ministry of Environmental Protection and as such has no control related to the development and implementation of the related processes.

4.5. MEASUREMENT, ASSESSMENT AND IMPROVEMENT

As noted earlier, MEP (NNSA) reviews the performance of divisions and staff in carrying out the activities of the annual plan each year. However, the requirements on management system review are applicable when the management system has been documented.

In developing its management system, MEP (NNSA) will need to ensure that the management system provides for management at all levels to evaluate the performance of work and the improvement of safety culture, and that it is monitored and measured to confirm that its processes achieve their intended results, and to identify opportunities for improvement.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: Requirement 19: The management system of the regulatory body states that** *"The regulatory body shall establish, implement, and assess and improve a management system that is aligned with its safety goals and contributes to their achievement."*
(2)	**BASIS: GS-R-3 §2.8-§2.10 states that** *"The documentation of the management system shall include the following:* - *The policy statements of the organization;* - *A description of the structure of the organization;* - *A description of the functional responsibilities, accountabilities, levels of authority and interactions of those managing, performing and assessing work;* *A description of the processes and supporting information that explain how work is to be prepared, reviewed, carried out, recorded, assessed and improved."*
R15	**Recommendation: MEP (NNSA) should establish and implement an integrated management system in conformance with IAEA SS GS-R-3.**

5. AUTHORIZATION

5.1. NUCLEAR POWER PLANTS

5.1.1. Overview

Authorizations needed for nuclear facilities and activities are specified in the following four regulation: Regulation on Safety Supervision and Management of Civil Nuclear Facilities, Regulation on Supervision and Administration of Civil Nuclear Safety Equipment, Regulation on Safety and Protection of Radioisotopes and Radiation-emitting Devices, and Regulation on Radioactive Substances Transportation Management Safety. The authorization process for nuclear facilities and activities is established in the respective Departmental Rules. Applications for authorization must be submitted to the MEP (NNSA). Then, the MEP (NNSA) organizes the technical safety review and receives comments from relevant departments of the State Council and local government. For important licensing decisions, consultation of the Nuclear and Radiation Experts Committee (Advisory Committee) of the MEP (NNSA) is required during the review process. In addition, concerning environmental impact reviews, the public has a possibility to present comments for a certain period of time. The MEP (NNSA) issues the relevant licenses.

5.1.2. Authorization of Nuclear Facilities

Nuclear facilities in China include nuclear power plants, nuclear power heat plants, nuclear steam and heat supply plants, research reactors, experimental reactors, critical assemblies, nuclear fuel cycle facilities, and radioactive disposal facilities. China implements a licensing system to nuclear facilities, thereby authorizing nuclear facilities-related activities such as siting, construction, first fuel loading, operation, and decommissioning. The MEP (NNSA) regulates nuclear activities by means of review and license approval, supervision, inspection and enforcement and urges licensees to undertake all necessary actions to bear their responsibility related to safety.

The nuclear industry in China is based on three major utilities. They have established separate companies for construction and operation of nuclear power plants and some organization of the licensee itself may be rather small.

As concerns nuclear power plants, licenses are required for sitting, Construction, Ratification of first fuel loading, Operation and Decommissioning. In addition, operators and senior operators working in the control room need a license issued by the MEP (NNSA). The licensing processes for research reactors and other civil nuclear power facilities are similar to those of nuclear power plants. For research reactors, two more license approvals are established, namely: Replacement of Operation License and Ex-Design Life Operation License. The duration of the Operation License of the nuclear power plant is the design lifetime of the facility, unless otherwise specified by the MEP (NNSA). The Initial Operation License of a research reactor is valid for 10 years. After the design life of the research reactor is exceeded, the MEP (NNSA) issues Operation License valid for at most 5 years.

The authorization process is carried out by reviewing and approving the documents, as established in the relevant Law and Regulations. Documents for authorization of nuclear power plants are as follows: for Siting Approval Content of site safety of the Nuclear Power Plant Feasibility Research Report and Environment Impact Report in stage of siting; for Construction License: Nuclear Power Plant Environment Impact Report in stage of design and construction, Nuclear Power Plant Preliminary Safety Assessment Report, and Quality Assurance Programme in stage of design and construction. For First Fuel Loading: Final Safety Analysis Report, Environment Impact Report in stage of operation, Commissioning Outline, Conformity Certificate of Operators, Emergency Plan, Construction Progress Report, In-service Inspection Outlines, Pre-service Inspection Results, Report on Commissioning before loading, Certificate of License of Possessing Nuclear Material, List of Nuclear Power Plant Operation Rules, Maintenance Scheme, and Quality Assurance Programme in stage of commissioning; for Operation License: Revised

Final Safety Assessment Report, Report on Trial Operation and Commissioning after Loading, and Quality Assurance Programme in stage of operation; for Decommissioning: Safety Assessment Report, Decommissioning Environment Impact Report, Quality Assurance Programme in stage of decommissioning. The MEP (NNSA) issues the Nuclear Power Plant License to applicant, if the contents of the documents listed above meet applicable requirements in regulations.

During operating stage, the MEP (NNSA) reviews and approves safety related plant modifications. Plant modifications affecting safety include: changes of structures, systems and components; revised operating limits and conditions; instructions and procedures modifications and organizational changes. The safety significance of the modification must comply with the requirements of Code on the Nuclear Power Plant Design (HAF102). If needed, the MEP (NNSA) consults the Nuclear and Radiation Experts Committee concerning the review results before decision-making. In addition, the licensee must carry out Periodic Safety Reviews (PSR) for their nuclear power plants. The Guide (HAD103/11) defines a ten year interval for PSRs. The MEP (NNSA) reviews and approves the safety factors to be assessed, the assessment methods and the evaluations submitted by the licensee. The authorization process of the PSR does not require an additional specific license, only providing the judgment whether the plant conditions meet applicable regulations and standards. Based on the review by the NSC, the MEP/ NNSA makes a decision concerning action to be taken by the licensee.

There are two types of licenses for the operation personnel; the Operator License and the Senior Operator License. Educational level, qualification, experience, health requirements and requirements for medical surveillance are specified in Chinese regulations. The validity period of the operator licenses is two years for nuclear power plants and three years for research reactors, after which time a new license is required. The licenses are automatically expired if the operator is out of duty for more than six months. The licenses for the operators of nuclear power plants and research reactors are granted by the MEP (NNSA). The main responsibility for the implementation of the programmes for training and retraining of the operation personnel and operator licensing examinations is held by the NEA. The examinations for operators include a written test, simulator tests and an oral test. The inspectors of the MEP (NNSA) supervise the licensing examinations and review training programmes of operators.

One of the responsibilities of the MEP (NNSA) together with the Ministry of Human Resources is to register nuclear safety engineers in China. At the end of 2009 there were about 1000 registered as a qualified nuclear safety engineer. The registration involves an examination based on four courses.

Inspectors of the MEP (NNSA) have to receive training and pass an examination on radiation safety, after which they will receive a Certificate on Nuclear Safety Inspection.

The authorization of nuclear facilities in China is considered to be generally consistent with international practices.

5.1.3. Authorization of Nuclear Safety Equipment

The MEP (NNSA) has strengthened its regulations on nuclear safety equipments supplied to the Chinese nuclear power plants, by promulgating the Regulation on Supervision and Administration of Civil Nuclear Safety Equipment in 2007. The equipment controlled by the regulation includes nuclear safety mechanical components such as pressure vessels, steel liner, heat exchangers, etc. and electrical components such as sensors, cables, and electrical penetrations, etc. Any organization in China which plans to design, manufacture, install, and examine by ND-methods nuclear safety equipment should apply for a license. The MEP (NNSA) is responsible for the review of the application and issuing the license. Foreign suppliers planning to design, manufacture, install and examine by ND-methods in China are subject to registration with the MEP/NNSA in advance. Under the current rapid expansion of nuclear power plant construction in China, these measures are expected to influence positively to high quality of classified nuclear safety equipment.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GRS Part 1 – Requirement 23: Authorization of facilities and activities by the regulatory body states that** *"Authorization by the regulatory body, including specification of the conditions necessary for safety, shall be a prerequisite for all those facilities and activities that are not either explicitly exempted or approved by means of a notification process."*
(2)	**BASIS: GRS Part 1 – Requirement 27: Inspection of facilities and activities states that** *"The regulatory body shall carry out inspections of facilities and activities to verify that the authorized party is in compliance with the regulatory requirements and with the conditions specified in the authorization."*
GP5	**Good Practice: The authorization procedures and regulations concerning nuclear safety equipment manufactured in China have been developed in recent years. The regulatory supervision has been strengthened and is organized in an effective way.**

5.2. RESEARCH REACTORS

The self-assessment of MEP (NNSA) has indicated that safety assessments prepared by the licensees of research reactors are not required to be verified by independent analysis. This observation has been corroborated in interviews made by the IRRS Review Team with MEP (NNSA) counterparts. The lack of independent verification is a shortcoming having safety significance.

There is no requirement legally binding the licensee to verify a safety assessment to be submitted to MEP (NNSA) through independent analysis; furthermore, there is no evidence that this is being performed in practice. This is not in conformance with the IAEA requirements and the international good practice.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-4, §2.19 states that**: *"A comprehensive safety assessment and independent verification shall be carried out to confirm that the design of the installation will fulfil the safety objectives and requirements, before the operating organization completes its submission to the regulatory body."*
R17	**Recommendation: MEP (NNSA) should make explicit requirements in revising the relevant code to ensure that applications submitted by the licensee that contain safety analyses results shall be verified by experts independent from those that were involved in the preparation of the application, reflecting existing practices.**

Many of the Chinese research reactors are in a non-operational state. Some of them may remain in a shutdown status for a long period of time. However, regardless of their operational status, research reactors are supervised by normal operational status requirements. The rules and regulations related to the design and operation of research reactors in their various lifecycles do not address an extended shutdown state. In a site visit, it was confirmed that the operator of one of the research reactors wanted to pursue a change in the license to that of a facility in extended shutdown. This request was not approved on the basis that the regulatory body did not have the relevant requirements in place.

No specific provisions exist in the regulations on extended shutdown of a research reactor thus the regulation does not address a safety relevant possible stage of the lifetime of such facilities.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-4, §6.71 states that**: *"Many research reactors are shut down for extended periods for various purposes, such as for modifications or for preparing for decommissioning.*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	Provision shall be made in the design to meet the needs arising in long shutdown periods, such as the needs for maintaining the conditions of the nuclear fuel, the coolant or the moderator, for the inspection, periodic testing and maintenance of the relevant SSCs of the facility, and for providing physical protection. Special consideration shall be given to long lived neutron poisons, which may affect the restarting of the reactor."
S14	**Suggestion: Acknowledging that MEP (NNSA) regulates all research reactors as in operational status, it should consider elaboration of regulations on the design and maintenance requirements related to the extended shutdown state of research reactors and critical assemblies.**

The Division of Nuclear Reactors, MEP (NNSA) is responsible for the regulatory supervision of research reactors and critical assemblies. This division has two permanent and one temporary staff members, including the division head. The regulatory supervision includes management of license applications for authorizations, modifications and other change request, management of review of the various licensee reports as well as of certain inspections in the lifecycle stages of siting, construction, construction and operation. Besides these basic regulatory duties the Division of Nuclear Reactors is assumed to perform various administrative and management tasks related to the 18 research reactors and critical assemblies being in various states in the People's Republic of China. This division also had in its scope of activities certain special projects (e.g., the licensing of the high temperature reactor pilot plant).

The staffing of the Division of Nuclear Reactors appears to be low and inadequate to the tasks assigned to this division. This fact may jeopardize the success of the regulatory supervision of the research reactors and critical assemblies. In addition, there will be competing priorities related to the assigned special projects.

Licensing practice of research reactors has been developed during recent times. The actual regulations (HAF 301) prescribes that the operational license of a reactor is valid for 10 years and can be renewed for another 10 years and subsequent 5 year periods.

Limitation of the validity period of research reactor operation license contributes to a safer operation and to a more effective regulatory control.

5.3. FUEL CYCLE FACILITIES

The People's Republic of China operates a number of various types of fuel cycle facilities. Different facilities may need different safety requirements and consequently different ways and methods of the regulatory supervision. In practice MEP (NNSA) adheres to this principle, however, no respective provisions exist in the actual regulations, department rules or standards. It became apparent from the discussions of the IRRS Review Team with MEP (NNSA) experts that in its actual practice MEP (NNSA) does not differentiate among the fuel cycle facilities as for the practice of their regulatory control.

Graded approach to the supervision of the fuel cycle facilities may enhance the efficiency of MEP (NNSA) as well as the safe operation of these installations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-5, §1.14 states that**: *"The implementation of the safety requirements for any fuel cycle facility shall be commensurate with its potential hazards (the 'graded approach'). The facility type and the … facility specific attributes shall be taken into account."*
S15	**Suggestion: MEP (NNSA) should consider applying a graded approach in a carefully**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	balanced manner to regulatory control over the various fuel cycle facilities, and this control should be commensurate with the potential hazard the facilities represent.

Subcontractors having a role in construction, modification or operation of a fuel cycle facility shall have regulatory supervision commensurate to that of the licensee in order to ensure a uniform safety level of the installation. Discussions of the IRRS Review Team with MEP (NNSA) experts have shown that MEP (NNSA) has no requirements as for the licensing of contractors working on the premises of a fuel cycle facility in roles important for safety.

A more thorough supervision (including possible licensing) of contractors working in a fuel cycle facility in roles important for safety may have beneficial effect on the operational safety of these installations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-5, §3.11 and 3.12 state that**: *"3.11. The regulatory body shall establish a planned and systematic programme of regulatory inspection (including provisions for unannounced regulatory inspections as necessary). The scope and frequency of the regulatory inspections under this programme shall be commensurate with the potential hazards posed by the facility.* *3.12. In addition to ensuring compliance with safety requirements, the programme shall take into account issues such as the safety culture of the operating organization, the adequacy of its resources (including the size of the workforce), the use of contractors and the arrangements put in place to ensure that workers are suitably qualified and experienced to perform their safety related tasks."*
S16	**Suggestion: With the increase in need for nuclear fuel cycle facilities in the future, MEP (NNSA) should consider whether it needs more formal means to achieve confidence in contractor qualifications having influence on the safe operation of fuel cycle facilities.**

Personnel of a fuel cycle facility need no license from MEP (NNSA). The regulatory body sets requirements on the qualification and training of the personnel and inspects training programme; however, discussions of the IRRS Review Team and the MEP (NNSA) staff revealed that no programme or procedure on regular and systematic control of the qualification and training is in place in MEP (NNSA).

Formalized supervision of the qualification and training of fuel cycle facilities could contribute to the safe operation of these installations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-5, §9.8 states that**: *"Minimum qualifications for personnel shall be specified, and these minimum qualifications shall be commensurate with the assigned functional responsibility and authority. The training of personnel working at the facility shall be commensurate with their assigned functional responsibilities, their authorities and their safety related activities. A training programme for personnel working at the facility shall be organized, staffed and managed to facilitate planning, direction, evaluation and control for fulfilling the training objectives. The training given shall be graded and shall be based on a competency framework."*
S17	**Suggestion: MEP (NNSA) should consider the elaboration of a procedure/programme for**

systematic supervision of the qualification and training of fuel cycle facility personnel.

Arrangements for decommissioning of a fuel cycle facility should be the subject of considerations from the very early stage of the lifecycle of the facility. Preliminary decommissioning plans usually are to be prepared together with the design of the installation. The plans are to be revised regularly during the operation of the facility in order to reflect changes relevant to conditions of the ultimate decommissioning. Although elements of decommissioning are considered in the SAR of a fuel cycle facility, the present practice of MEP (NNSA) is not conforming to this requirement, fuel cycle facilities have usually no decommissioning plans since no regulations for this exist.

Decommissioning plan of a fuel cycle facility is integral part of its safety documentation. Lack of decommissioning plan is against the best international practice, existence of such plans make the preparations for decommissioning safer and more efficient.

5.4. INDUSTRIAL, MEDICAL AND RESEARCH FACILITIES

Requirements for authorizations are established in the regulations no. 449 (2005) and the Rule on Licensing Management of Safety and Protection for Radioisotopes and Radiation-emitting Devices (2006). Other documents (e.g., the mandatory Basic Safety Standards (GB18871-2002)) provide further elaboration.

The different authorities involved in regulatory control issue authorizations in the area of their respective legislative responsibilities.

If a facility or activity has a Category I source, then the practices associated with that source are authorized by MEP (NNSA). Categories II-V are authorized by the provincial the Provincial Environmental Protection Administration Bureau (provincial EPB). For medical facilities and activities, an additional authorization is required from DoH.

Authorizing the use of radiation sources is a two stage process. An authorization is required prior to construction. A pre-requisite is the submission of an environmental impact assessment (EIA) and is called ‘Approval of Environmental Impact Report’.

Clear application forms and instructions are available, inter alia via the internet, to those applying for a license to conduct a radiation practice. Information required is graded according to the Category of the sources and seems to be in all observed cases sufficient. The processes for submitting and reviewing applications appear to be well formalised, and a period of 20 days for decision making is set in Article 9 of the regulations no. 449, with the obligation for the regulatory body to make a decision.

For facilities and activities involving category I sources or radiation-emitting equipment, review and assessment of applications is done by NSC.

The degree of complexity of EIA is commensurate with the radiation risk associated with the facility or activity in accordance with a graded approach. For Category I sources and radiation-emitting equipment, the EIA guide prepared by NNSA covers the following elements:

- Legal basis for the EIA;
- Dose limits, protection target and assessment scope;
- Siting;
- Engineering analysis of source term;
- Radiation protection, safety and security measures including equipment;

- Shielding;
- Waste management, including pre-disposal management on-site;
- Environmental impact of the proposed practice, including impacts during construction and operation and impact analysis in case of accidents;
- Safety management organization for radiation safety including organization responsibilities and staff and emergency response arrangements including nomination of responsible persons including RPO;
- Statement of justification and optimization by proponent based on Chinese BSS. For Category I sources, the EIA includes a requirement for a detailed cost benefit analysis; and
- Formal documentation of public consultation including information to the public about the radiation risks involved and the safety measures employed to protect human health and the environment in addition to a statement by the applicant as to the success of the public consultation process.

Inspections during construction are conducted to ensure that the radiation safety elements agreed to for the construction approval are properly implemented.

Applicants can get assistance for the preparation of EIA from external experts.

Additionally for medical uses of radiation, a radiation hygiene review (RHR) is requested to support the application for a DoH authorization. The elements of the RHR include occupational exposure protection, which is also an element of EIA.

Each application for an authorization to use a sealed radioactive source of category I, II or III has to include an agreement to return disused sealed radioactive sources to the supplier. A copy of that agreement has to be attached to the application. This applies also to domestically supplied radioactive sources. Domestic manufacturers and suppliers must have the ability to receive disused sources back and be able to manage them safely. However, there is no requirement for financial provisions for the safe management of disused sources.

For Category IV and V sources, no agreement to return the source to the supplier is requested. The source can either be returned to the manufacturer or to a domestic radioactive waste management facility.

According to article 13 of the regulations no. 449, applications to renew an authorization must be submitted one month in advance for all practices.

In case of authorization modification (e.g. new sources), the validity of the license will be limited to the remaining period of validity of the original license.

Failure to get the authorization renewed before the expiry of the existing authorization is considered a violation of the regulations. The operation is required to stop and corrective actions have to be implemented within a limited period of time specified by the regulatory body. Article 59 of the regulations no. 449 includes mechanisms for the safe management of the sources if the facility fails to implement the corrective actions within the specified time limit.

The authorization system is implemented in accordance with the categorization of sources and radiation-emitting equipment. The IRRS Review Team observed that the same authorization process is applicable to all licensees, irrespective of the category of sources and equipment in their facilities or activities. However, the scope of the process, i.e. the contents and level of details requested, is graded according to the category of sources or equipment.

Import authorization

A company importing radioactive sources to China shall have a sell-authorization granted by MEP (NNSA). This is a general authorization defining the scope (radionuclides and activities) of the sources that can be imported. In addition, a separate approval from NNSA is required for each import transaction.

The end user of the source must have an authorization for use before an import transaction can be approved; a copy of that authorization shall be attached to the application for approval.

This approval is an integral part of the subsequent import administrative procedures including those requested by the Customs[1].

Within 20 days after receiving the imported source, the end user shall register the source at the provincial EPB.

Agreement from the supplier abroad to receive the source after being disused is only requested for the import of Category I-III sources.

Export authorization

In order to export a radioactive source from China, an export authorization granted by the MEP (NNSA) is required. In order to demonstrate that the receiver in the importing country is authorized to receive the source, the applicant shall attach a copy of the user license from the importing country. The IRRS Review Team was advised that no notification prior to shipment is sent to the importing State.

The same procedure applies to all Category I – V sources. This fact is not fully consistent with provisions of the *Guidance on the Import and Export of Radioactive Sources*, according to which the exporting state should obtain consent from the importing state before authorizing the export of Category I source and the exporting state should send a notification to the importing state prior the shipment.

Authorization for Transfer of sources

If a radioactive source is to be transferred from one facility to another, the transferee shall submit an application for transfer approval to the transferee's provincial EPB. The transferee shall have an authorization for use before the transfer can be approved. In case where the transferor and transferee are located in different provinces, the transfer shall be jointly approved by both provincial EPBs. After the transfer has taken place, both parties have to inform their respective EPBs within 20 days.

In case where a radioactive source may be used in more than one province (e.g. industrial radiography company having mobile sources), the authorization for use is granted by the provincial EPB of the province where the facility is registered. If the source is to be used in other province the licensee shall register to the province EPB[2] where the sources be used.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS:** Guidance on Import and Export of Radioactive Sources *Sections VII and VIII*
S18	**Suggestion: The MEP (NNSA) should consider ensuring that the provisions of the Guidance on Import and Export of Radioactive Sources are fully followed, as far as practicable.**

[1] Within customs operations, the integrity of the package containing the imported sources is examined by a technical department of the local government. Customs has also a dedicated store for hazardous material.

[2] This approval is not a full license. The user has to submit information on the source, location of the proposed use, copy of the use license. For issuing the approval, the destination province may conduct inspection to the use locations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: CoC, 22 (b) 22. Every State should ensure that its regulatory body:** *(b) ensures that arrangements are made for the safe management and secure protection of radioactive sources, including financial provisions where appropriate, once they have become disused;*
R18	**Recommendation: The regulatory body should establish requirements for financial provisions for the safe management of disused sources.**
(1)	**BASIS: GSR Part I para 4.33 states that** *"4.33. Prior to the granting of an authorization, the applicant shall be required to submit a safety assessment [8], which shall be reviewed and assessed by the regulatory body in accordance with clearly specified procedures. The extent of the regulatory control applied shall be commensurate with the radiation risks associated with facilities and activities, in accordance with a graded approach."*
S19	**Suggestion: The regulatory body should consider enhancing the implementation of the graded approach by adjusting the authorization process according to the category of the sources.**

5.5. WASTE FACILITIES

Waste minimization

There have been substantial efforts to reduce the generation of radioactive waste at the nuclear power plants and this is done already at the design stage of the plants. As part of licensing, operators of nuclear power plants submit to MEP (NNSA) a plan for minimization of radioactive waste as part of the overall waste management plan. This waste minimization plan is not yet a regulatory requirement (i.e., not yet mandatory), however, it represents good practice. This regulatory practice represents a direct implementation of Principle 7 of IAEA safety standards series No. SF-1. Examples of such plans were presented for the nuclear power plants at Daya Bay and Hongyanhe.

The Guangdong Beilong LILW Disposal Site

The Guangdong Beilong low and intermediate level waste disposal site (Beilong Disposal Facility) is located on the Dapeng Peninsula, about 5 km away from Guangdong Daya Bay Nuclear Power Plant. The Beilong Disposal Facility is designated to accept LILW waste arisings from nuclear power plants and, eventually from nuclear technology applications in the southern part of China. The site selection and environmental impact assessment report for the Beilong Disposal Facility started in June 1991. The State Environmental Protection Administration SEPA (NNSA) finished review of the environmental impact assessment report for siting and issued the approved siting license in December 1994. In August 1997, the review of the environmental impact assessment report for the construction application was completed. The construction license was issued by SEPA (NNSA) and in the early of 2000, the first disposal units were constructed at the site.

According to the operational license application document, the radioactive wastes to be accepted for disposal in the Beilong Disposal Facility are solid LILW, and does not include disposal of disused sealed radioactive sources. The waste acceptance criteria (WAC) in the operational license application document specify, among other things, that the average long-lived alpha activity in the waste disposed at the site should not exceed 3.7×10^5 Bq per kilogram of waste.

MEP (NNSA)'s 2006 annual report for the Guangdong Beilong LILW Disposal Site (pg 36) reports that: *"Report on Environmental Impact for Guangdong Beilong Low and Intermediate Level Waste Disposal Repository (operations application)" was reviewed in 2006. It was agreed that 590 barrels of C1 and 168*

barrels of C4 cement waste, total volume of 1403.2 m^3 arising from Daya Bay NPP and LingAo NPP, temporarily stored in the cell No. 1 and No. 2 of the repository. Guangdong Daya Bay Nuclear Power Environmental Protection Limited Corporation takes the responsibility for it's maintain and operation."

Paragraph D-17 of China's 2009 report to the 3rd review meeting of the Joint Convention reports that *"Now, there are two solid LILW disposal sites in trial operation in China. Annex L.4.4 lists the volume of wastes which have been received for disposal."*

Due to the expansion of nuclear power it has been concluded that the capacity of the Beilong Disposal Facility may not be sufficient and other disposal options are being considered. Thus, the Beilong Disposal Facility is authorized for trial operation. In accordance with this authorization the disposal units cannot be backfilled nor capped.

In connection with the operating license for the Beilong Disposal Facility, the IRRS Review Team was informed that: (1) the environmental impact report has been reviewed and assessed by MEP (NNSA) and the safety issues have been adequately addressed by the applicant, and (2) most other requirements for granting the operating license have been fulfilled. However, the Beilong Disposal Facility is still operating with a temporary authorization.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: Safety Fundamental-1 Principle 7: Protection of present and future generations states that** *"People and the environment, present and future, must be protected against radiation risks."*
R19	**Recommendation: MEP (NNSA) should establish a formal legal requirement to have a waste minimization plan as part of the application for a license.**
(1)	**BASIS: SSR-5 – Requirement 11: Step by step development and evaluation of disposal facilities states that** *"disposal facilities for radioactive waste shall be developed, operated and closed in a series of steps. Each of these steps shall be supported, as necessary, by iterative evaluations of site, of the options for design, construction, operation and management, and of the performance and safety of the disposal system."*
S20	**Suggestion: MEP (NNSA) should encourage the operator of the Beilong Disposal Facility to apply for an operating licence for the facility, be that as a disposal facility or as a storage facility. The current temporary operating permit is not a sustainable situation.**

6. REVIEW AND ASSESSMENT

6.1. NUCLEAR POWER PLANTS

6.1.1. Overview

The MEP (NNSA)'s review and assessment covers the whole life cycle of nuclear facilities including siting, construction license, commissioning, first loading, operation license, periodic safety review and decommissioning. It also covers activities such as nuclear materials transport, nuclear safety equipment manufacturing and also radioactive sources.

The objective of the review and assessment function is to verify conformity of the facilities, equipment or activities with the national nuclear regulations, in particular with the administrative regulations issued by the State Council and the departmental rules issued by MEP (NNSA) and other applicable safety regulations.

The divisions of the Department of Nuclear Safety Management of the MEP (NNSA) that are especially involved in the review and assessment of the nuclear facilities are the three Divisions of Nuclear Power Plants, the Division of Nuclear Reactors, the Division of Nuclear Fuels and Transportation, the Division of Radioactive Waste Management and the Division of Nuclear Components Equipment. Other divisions may also participate in specific aspects of the review and assessment on their own area.

The headquarter of MEP (NNSA) is dependent on its dedicated technical support to discharge its duties for review and assessment activities. The MEP (NNSA) arranges these activities with its TSOs. The Nuclear and radiation Safety Centre (NSC) is its main TSO and covers most of the review and assessment work that the headquarters of MEP (NNSA) is responsible for. Since the NSC is under the same ministry as the MEP (NNSA), no contracts are needed between them. In addition to the NSC, other TSOs are used based on contracts. Issues related to CANDU reactors are entrusted to the Beijing Nuclear Safety Review Centre. Technical assessment of research reactors is entrusted to the Suzhou Nuclear Safety Centre and the Nuclear Equipment to Nuclear Installations Safety and Reliability Centre of Mechanical Institute. Other TSOs or experts may be contracted for specific tasks.

The functions of headquarters of MEP (NNSA) personnel engaged in the review and assessment activities are essentially those of a project manager. The project managers are responsible for coordinating the work that is entrusted to its TSOs, communicate with their counterparts in these organizations for arranging the work plan and the schedule of the tasks to be carried out. They also follow that the work is done according to agreed schedule.

Especially to support its review and assessment activities, the MEP (NNSA) has a Nuclear and Radiation Experts Committee (Advisory Committee). It has 100 members from universities, research institutes, other governmental organizations, utilities and the MEP (NNSA) itself. The Advisory Committee has on the average 10 assembly meetings a year and one meeting of the whole committee a year. The experts of the MEP (NNSA) and NSC that were interviewed revealed that the work of the Advisory Committee is important. It was emphasized that the members of the Advisory Committee coming from utilities are not representing their utilities but are there as experts.

The process followed by the MEP (NNSA) to carry out the review and assessment is as follows:

- the concerned division of the headquarters of MEP (NNSA) receives the initial application from the licensee. Then a draft work order is prepared by the nominated project manager to be sent to one of the TSOs;
- after preparation of the draft work order, the project manager arranges a meeting with the appointed TSO and discusses the review plan;
- the TSO appoints a person responsible for coordination of its internal work. He is also responsible

for informing the MEP (NNSA) headquarters project manager about the progress of work;

- during the review, the TSO may need additional information from the licensees to complete the review. The MEP (NNSA) headquarters project manager will arrange review meetings with the licensees at the request of the TSO whenever required. Depending on the issue, one to three rounds of questions and answers are needed and typically two review meetings and one issue meeting with the applicant are arranged; and
- when the review and assessment has been completed by the TSO, a draft of the Safety Evaluation Report is discussed with the MEP (NNSA) project manager after which the final report is sent to the headquarters of MEP (NNSA).

The project manager of the MEP (NNSA) is in charge to prepare a summary report concerning the application and review findings. After approval by the head of the Division, the Safety Evaluation Report together with the summary report prepared by the project manager is sent to the Director General for decision-making. The DG of the NSC is involved in the MEP (NNSA) headquarter's meetings where the major licensing decisions are discussed.

When the review and assessment involves granting licenses (construction, first fuel loading, operation...) or is otherwise especially important, the outcomes of the review are discussed with the Advisory Committee and with other state, regional or local authorities in accordance with the regulations.

Public participation is possible in case of Environmental Impact Reports, which are placed on www-pages for public consultation for seven days according to a State law.

The final decision, granting or denying the application, is then communicated to the licensee by means of an official letter.

Concerning the review of the PSAR and FSAR NSC is following closely the US NRC practices as concerns the review process. The PSAR has to be provided for review at least 12 months before first concreting pour and the FSAR 12 months before first fuel loading. As an example the different phases of the AP 1000 regulatory review were discussed thoroughly in the interviews. In the case of AP 1000 the review was performed by the NSC in 12 months.

On overall level the use of TSOs is well managed by a yearly plan and contracts made with TSOs.

The process adopted by the MEP (NNSA) for the review and assessment is considered to be generally consistent with international practices.

6.1.2. Resources and competence

The current technical capability for review and assessment lies on TSOs. The project manager of the headquarters of MEP (NNSA) must be capable to produce summary reports, based on the work of the TSO, which consider all applicable regulations. The headquarters MEP (NNSA) is responsible for the decision-making and it should have within its own staff a core competence for that.

The main TSO, NSC, which is directly affiliated to the MEP (NNSA), is rapidly increasing its resources. In the beginning of this year they had in their 14 divisions a staff of 230 people and by the end of this year they intend to have about 300 and by the end of 2012 about 600. In the long term, by 2020, they plan to have a staff of 1000-1200. The staff size by 2012, 600 people has been approved by the State Council which means that the funding is secured for this first phase. The plan to increase the number of staff is based on comparisons that they have made with some foreign regulatory organizations, especially those of USA, France and Korea.

Some experts that were interviewed were of the opinion that the planned number of staff by the end of 2012 (600) is not adequate taking into account the challenges ahead and that additional resources from universities and research institutes are needed. They already had initiated preliminary discussions with

these organizations which are eager to participate in these activities. The funding from the MEP (NNSA) to the NSC has to be secured for this purpose.

The experts from the NSC that were interviewed estimated that about one third of the increase of staff would come directly from universities. For these newcomers, an initial training programme which comprises two months initial training and six months on-the-job training at a site was not considered to be very comprehensive.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GRS Part 1 - Requirement 11: Competence for safety states that "***The government shall make provision for building and maintaining the competence of all parties having responsibilities in relation to the safety of facilities and activities."*
(2)	**BASIS: GRS Part 1 - Requirement 11: Competence for safety §2.38 states that "***Development of the necessary competence for the operation and regulatory control of facilities and activities shall be facilitated by the establishment of, or participation in, centres where research and development work and practical applications are carried out in key areas for safety.***"**
(3)	**BASIS: GRS Part 1 - Requirement 18: Staffing and competence of the regulatory body states that** *"The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities."*
R20	**Recommendation: The headquarter MEP (NNSA) should assess its current and future needs for internal technical expertise considering especially its decision-making functions.**

6.1.3. Analytical methods

The use of analytical methods in the review and assessment as concerns different NPP designs was discussed thoroughly with experts from the NSC. For each design that is in operation or under construction the NSC attempts to perform independent verification analyses for deterministic accident analyses. For the AP 1000 and EPR design, no such analyses were performed in the construction license phase but are planned to be performed in the operating license phase. As concerns the AP 1000, the accident analysis computer codes to be used will be received from the US NRC based on a contract. Concerning the EPR, the codes have not yet been finally selected. Codes are available for Generation II design and the VVER. Codes are available also for radiological consequence analyses.

Analyses related to the power uprates of the Generation II reactors were discussed. In some cases the margins to acceptance criteria were rather small. A careful examination and review including uncertainty analyses concerning power uprates is important.

For the HTGR and fast reactors as well as for research reactors the NSC does not have applicable tools to perform independent verification analyses. It was also said that there are not adequate resources to perform all the analyses with different codes that the NSC would like to do.

NSC has a separate budget for accident analysis computer codes. They also have a budget to design and construct simulators to train their own staff and to verify the EOPs of the NPPs. The first one will be a Generation II simulator and AP 1000 and EPR will then follow.

To be able to develop methods and tools for review and assessment activities, research is needed. The next five year State research plan is being developed at the moment and the MEP (NNSA) together with the NSC are preparing the nuclear safety research part of it. The focus of that programme will be on advanced reactor designs and especially on experimental verification of the safety of the planned power

increase of the AP 1000.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GRS Part 1 - Requirement 25: Review and assessment of information relevant to safety states that** *"The regulatory body shall review and assess relevant information — whether submitted by the authorized party or the vendor, compiled by the regulatory body, or obtained from elsewhere — to determine whether facilities and activities comply with regulatory requirements and the conditions specified in the authorization. This review and assessment of information shall be performed prior to authorization and again over the lifetime of the facility or the duration of the activity, as specified in regulations promulgated by the regulatory body or in the authorization."*
(2)	**BASIS: GRS Part 4 - Requirement 18: Use of computer codes states that** *"Any calculational methods and computer codes used in the safety analysis shall undergo verification and validation."*
S21	**Suggestion: NNSA should perform appropriate conformational analysis and verification for nuclear facilities accident analyses in the construction license phase, where possible acquiring adequate tools.**

6.1.4. Specific assessments

Probabilistic Safety Assessment (PSA)

The safety of the Chinese nuclear power plants relies essentially on a deterministic approach based on the concept of defence in depth using conservative assumptions and analytical methods to meet acceptance criteria. As a complement to the deterministic approach, probabilistic safety assessments are used to evaluate the risk arising from the facilities. For each type of reactors to be constructed in China, the licensee has performed a reference PSA. For operating reactors, a summary of the reference PSA is included in the safety analysis report compiled for Periodic Safety Review. For future reactors, results of a reference PSA are mainly used to optimize the design.

To review PSAs and to perform sensitivity analyses the NSC has a Swedish code. The plant models are provided by the licensees. The PSA is used mostly to assess the design of nuclear facilities. Risk-informed applications of PSA such as inspections, testing etc. have not yet been developed.

The MEP (NNSA) published the Code on safety of nuclear power plant design and the Code on the safety of nuclear power plant operation in 2004, and released guidelines for safety evaluation and verification on probabilistic safety analysis in 2006. This year, in 2010, the MEP (NNSA) published a Policy Statement on "Probabilistic safety analysis in nuclear safety in the field of application" for trial implementation. This policy document notes the importance of the Defence in Depth and emphasizes the importance of understanding risks in decision-making and the quality of PSA. It is supposed to provide the basis for the Chinese nuclear regulatory body to improve the efficiency of nuclear safety regulation. It is suggested that the MEP (NNSA) should establish a mid and long term plan to develop an implementation plan programme on the use of risk insights, especially as concerns PSA applications and in the area of nuclear regulation.

Related to the PSA, the requirements in the regulations and the actual practices were discussed. It was found out that Level 3 PSAs for internal and external events are required in HAF 102, but in practice only Level 1 analyses for internal events are requested. This practice is based on the Evaluation Principles issued by the MEP (NNSA) for this kind of reviews. The Evaluation Principles are also discussed in Ch.9 Regulations and Guides.

These applications could cover risk-informed Limiting Conditions for Operation (Technical Specifications), risk monitoring and maintenance planning, risk-informed in-service inspection and testing etc. Mid and long term plans should be developed to implement these regulations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GRS Part 1 - Requirement 25: Review and assessment of information relevant to safety states that** *"The regulatory body shall review and assess relevant information — whether submitted by the authorized party or the vendor, compiled by the regulatory body, or obtained from elsewhere — to determine whether facilities and activities comply with regulatory requirements and the conditions specified in the authorization. This review and assessment of information shall be performed prior to authorization and again over the lifetime of the facility or the duration of the activity, as specified in regulations promulgated by the regulatory body or in the authorization."*
R21	**Recommendation: In developing safety guides, regulations and Evaluation Principles MEP (NNSA) should ensure that there are no conflicts.**
(1)	**BASIS: SSG-3 §2.22 states that** *"PSA can provide useful insights and inputs for various interested parties, such as plant staff (management and engineering, operations and maintenance personnel), regulatory bodies, designers and vendors, for making decisions on:* *(a) Design modifications and plant modifications;* *(b) Optimization of plant operation and maintenance;* *(c) Safety analysis and research programmes;* *(d) Regulatory issues."*
S22	**Suggestion: The MEP (NNSA) should consider developing guidance concerning the use of PSA for key applications, and should consider starting to risk-inform its own regulatory functions to optimize regulatory activities and develop an implementation programme for that purpose.**
(1)	**BASIS : SSG-3 §2.22 states that** *"as plant staff (management and engineering, operations and maintenance personnel), regulatory bodies, designers and vendors, for making decisions on:* *(a) Design modifications and plant modifications;* *(b) Optimization of plant operation and maintenance;* *(c) Safety analysis and research programmes;* *(d) Regulatory issues."*
GP6	**Good practices**: **The MEP (NNSA) supports the wide use of PSA by issuing a PSA Policy Statement.**

Event assessment and operating experience feedback

In the case of a significant incident at a nuclear facility the MEP (NNSA) will send a team of experts to assess the causes of the incident and the situation at the facility. The members of the group are from the MEP (NNSA) headquarter, MEP (NNSA) regional office and the NSC. The group can interview the manager of the facility and for example the control room operators. The assessment report is discussed with the utility and finally the MEP (NNSA) makes a decision concerning the corrective actions need to be taken. The procedure for non-routine inspections is followed. The assessment focuses on technical

issues.

The MEP (NNSA) has defined in their regulations what reports the licensee has to send to the MEP (NNSA) concerning commissioning and operation of nuclear facilities. The ways of reporting events are:

- oral notification within 24 hours;
- written notification in three days;
- event report in 30 days; and
- accident report in an emergency condition.

The NSC reviews the incident reports for the MEP (NNSA). The NSC also has a database concerning all incidents that have taken place in China. They perform analyses based on this data to find recurring incidents and they propose to the MEP (NNSA) Information Notices to be sent to all utilities in China. The NSC also reviews incident reports from other countries.

The industry has its reporting requirements and a database, which they assess separately from the MEP (NNSA). The CAEA has organized a special committee to decide which incidents should be reported to the IAEA. The chair of the committee is from the CAEA and the MEP (NNSA) participates in the committee meetings. As noted in section 2.2 of this report, CAEA is the National IRS Coordinator.

China also participates in many international activities concerning operating experience feedback.

The NSC collects information concerning significant incidents and assesses the information in the database regularly. Based on these assessments, the NNSA prepares Information Notices to be sent to the licensees concerning lessons to be learned from operating experiences.

Organizational and Safety Culture assessments

The MEP (NNSA) is not performing any specific safety culture assessments. It was discussed that some utilities have asked IAEA to perform some safety culture related missions. Within the NSC there is a division to review QA systems. All these QA experts have a technical educational background. For reviewing human factor issues another TSO, Hunan Engineering Institute is used.

Safety Indicators

The NSC has in trial use a safety indicator system which is similar to NRC's indicator system. All Chinese NPPs report to that system.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 – Requirement 11: Competence for safety states that** *"The government shall make provision for building and maintaining the competence of all parties having responsibilities in relation to the safety of facilities and activities."*
S23	**Suggestion: The MEP (NNSA) should consider ensuring that they have adequate capability to review human factors and safety culture related issues in the light of the nuclear industry expansion.**

6.2. RESEARCH REACTORS

The PRC research reactor programme consists of 18 facilities. Some of them were licensed before the foundation of MEP (NNSA). For these facilities, MEP (NNSA) performed a retroactive assessment of these facilities against current safety regulations. Furthermore, these research reactors go through a license extension review every five years. The relicensing involves a periodic review of the facility including an assessment against current regulations. The research facilities licensed after the mid-1990s are licensed for 20 years. Following the first 10 years of operation, these facilities also performed these

periodic reviews. After the 20 years, these research reactors are also subject to the 5 year license renewal. This practice of evaluation of research reactors against current requirements is highly appreciated by the IRRS Review Team.

6.3 FUEL CYCLE FACILITIES

The Safety Analysis Report (SAR) is one of the most important documents of a nuclear facility and is one of the principle documents establishing the licensing basis of a fuel cycle facility. The SAR is meant to give a detailed demonstration of the safety of the facility, thus it should reflect all important modification in the facility configuration that may have safety implications. Yet no provisions are in force to require periodic or occasional revision of the SAR documents.

Regular revision of the SAR could make this document more closely reflect the actual safety of the fuel cycle facilities thus contributing to a more efficient supervision of the facility.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-5, §2.15 states that***: "The licensing documentation shall be maintained and updated during the operational lifetime of the facility on the basis of the experience and knowledge gained and in accordance with the regulatory requirements, with account taken of modifications to the facility."*
R22	**Recommendation: MEP (NNSA) should require the updating of the SAR of fuel cycle facilities on a regular basis as well as following important modifications that have an effect on the safety of the installation.**

According to the information provided by MEP (NNSA) safety analyses of fuel cycle facilities are to be reviewed and assessed by the Nuclear and Radiation Safety Centre (NSC), the internal TSO of MEP (NNSA). In the course of the discussions between the IRRS Review Team and the MEP (NNSA) staff it became clear that for lack of internal resources review-related criticality calculations are performed by contractors outside NSC. The contracting organization identified by NSC is the China Institute of Atomic Energy, the main research institution of CNNC. CNNC is the operator of several nuclear fuel cycle facilities.

The outsourcing practice of NSC in case of the criticality calculations may not exclude the possibility of conflict-of-interest and so may raise the shadow of doubt on the independence of the verification of calculations submitted by the licensee.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-5, §3.4 states that** *"To be effective, the regulatory body shall be provided with the legal powers and statutory authority necessary to ensure that it can discharge its responsibilities and perform its functions. Such powers normally include the authority to review and assess safety information submitted by the operating organization in the authorization process and to administer the relevant regulations, including carrying out regulatory inspections and audits for compliance with the regulations, taking enforcement actions, and providing information to other competent authorities and to the public, as appropriate."*
(2)	**BASIS: GS-R-Part1, §4.9 states that** *"To maintain its effective independence, the regulatory body shall ensure that in its liaison with interested parties it has a clear separation from organizations or bodies that have been assigned responsibilities for facilities or activities or their promotion"*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
R23	**Recommendation: MEP (NNSA) should make the necessary steps to provide adequate resources in order to make it able to perform all the assessment and review work necessary to support the MEP (NNSA)'s regulatory supervision of fuel cycle facilities, especially for spent fuel facilities. Analyses provided by organizations outside of the regulatory body should be ensured to be independent of the nuclear operators.**

Periodic safety reassessment of fuel cycle facilities is necessary in order to confirm that the licensing documentation of the facilities remained valid or have been properly modified since the latest revision. Such reviews shall be the bases for the safe continued operation of the facilities. Although MEP (NNSA) introduced the practice to require periodic safety review as part of the operating license conditions, no corresponding regulation has so far entered into force.

Furthermore, licensees need regulatory guidance as how to perform the safety review, but no respective guidance is yet available.

A legally binding time-frame for performing periodic safety review of fuel cycle facilities may highly contribute to the effectiveness of the regulatory supervision of these facilities. Regulatory guidance on the recommended way of performing PSR may help the licensee to cope with the regulatory requirements.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-5, §9.68 states that**: *"The operating organization shall carry out a systematic reassessment of the safety of the facility at regular intervals, and in accordance with national regulatory requirements, to deal with the cumulative effects and implications of ageing, modifications, technical developments, operating experience and changes in the site characteristics."*
S24	**Suggestion: MEP (NNSA) should consider setting requirements on the frequency of the periodic safety review of fuel cycle facilities and the issuance of regulatory guidance on periodic safety reviews for fuel cycle facilities.**

6.4. INDUSTRIAL, MEDICAL AND RESEARCH FACILITIES

For the control of radiation sources, review and assessment is done primarily within the authorization process.

For Category I sources, review and assessment is made by MEP (NNSA). The review and assessment process is a formal, documented process triggered by MEP (NNSA). The result of such review and assessment is sent back to MEP (NNSA) which will consider it in making its regulatory decision.

For sources authorized by the Provincial Environmental Protection Administration Bureau (provincial EPB), review and assessment is mainly made by that EPB. If needed, technical support by external experts is sought. The IRRS Review Team was informed that the external experts have to be registered, and a database is maintained for those external experts. Individuals wishing to be external experts have to apply for registration in the respective provincial EPB and their application will be assessed before registration. However, this procedure is not equivalent to formal recognition.

According to article 30 of the regulations no. 449, all authorized facilities have to submit an annual self-assessment report to MEP (NNSA), its regional offices or the provincial EPB as applicable. This self-assessment report will be reviewed and assessed following a formal review and assessment procedure. The requested content of the self-assessment report and the details of the review and assessment are in accordance with a graded approach.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: BSS Definition of qualified expert: "***An individual who, by virtue of certification by appropriate boards or societies, professional licences or academic qualifications and experience, is duly recognized as having expertise in a relevant field of specialization, e.g. medical physics, radiation protection, occupational health, fire safety, quality assurance or any relevant engineering or safety specialty."*
S25	**Suggestion: The MEP (NNSA) should consider to establish procedures for formal recognition of external experts in the field of radiation protection.**

6.5. WASTE FACILITIES

In general the procedures for application, review and assessment, license issuing, information which needs to be submitted to MEP (NNSA) are defined in "Rules for the Implementation of Regulations on the Safety Regulation for Civilian Nuclear Installations — Part One: Application and Issuance of Safety License for Nuclear Power Plant" (HAF001/01).

National law in China requires that an environmental impact report (EIR) be prepared for each licensing step in the development of a near surface disposal facility, namely for siting, construction, operation and closure. The EIRs must be prepared by certified organizations. Details on the content and structure of EIRs (which includes the safety case) are summarized in regulatory guidelines. The content of the disposal EIR for near surface disposal facilities can be found in guideline HJ/T 5.2-93.

The MEP (NNSA) process for review and assessment of licensing submissions for waste-related facilities includes review by an MEP (NNSA) inter-divisional expert review committee that evaluates the EIR together with the recommendations of the TSO for license conditions. The committee provides feedback to the TSO and they make recommendations to the NNSA decision makers.

The China Institute of Radiation Protection (CIRP), which is certified by MEP (NNSA), prepared the EIR for the operational license application for the Guangdong Beilong Solid LILW Disposal Site. Responsible staff within CIRP are certified (by MEP (NNSA)) for preparation of EIRs for near surface disposal of radioactive. In 2005, Nuclear and Radiation Safety Centre (NSC) reviewed the EIR for the operational license application for the Beilong disposal facility and provided a final review report to MEP (NNSA).

As part of their review and assessment, NSC performed control calculations. Other approaches to provide independent confirmation of the applicant's safety analysis include use of independent experts (e.g., using specialized consulting companies) or international peer review services such as those provided by the IAEA.

It should be noted that CIRP also functions as a TSO for MEP (NNSA) in the development of regulations and guides. Hence, CIRP both prepares EIRs on behalf of operators of waste management facilities and is involved as a TSO in the formulation of regulations and guides for MEP (NNSA). Although there is functional separation within CIRP there is no formal procedure for preventing a conflict of interest between these two areas.

7. INSPECTION

7.1. NUCLEAR POWER PLANTS

The inspection programmes for the operating nuclear power plants and the new plants under construction, are overseen by MEP (NNSA). These inspections are conducted by individuals at each nuclear power plant site, termed resident inspectors, inspectors from the regional office in which the nuclear power plant is located, and specialist inspectors from the MEP (NNSA) Headquarters. There are six regional offices, which have one division that has responsibility for inspection of the nuclear power plants located within that region.

The programmes also define the functions for relevant branches of MEP (NNSA), and include inspection of manufacturers of certain specified safety equipment.

Daily inspection are performed by the resident inspectors; routine inspections and non-routine inspections are normally organized by MEP (NNSA) Headquarter and its regional office , supported from the Technical Support Organizations (TSOs) in China, if needed.

The inspection programme is systematic and very structured in the law and regulation, a programme document, an annual inspection plan for each nuclear power plant (NPP) or construction site, and inspection procedures. The programme document describes who performs inspections, the frequency, and the type or general category of inspections that should be conducted during each phase of operation of a nuclear power plant (e.g., construction, operation, decommissioning, etc.). The general programme is supported by an annual plan for each NPP or unit under construction. These programmes and procedures are focused on the technical items to inspect and some provide guidance for examining NPP programmes, which are related to identifying and correcting problems, establishing a safety first culture, other technical programmes etc. Individual inspections are very thorough and address the key safety issues identified in the guidance and procedures. The inspectors have unfettered access to the licensee facilities and information needed to successfully complete inspections and to independently examine licensee operations and construction activities.

MEP (NNSA) also has a programme for inspection of manufacturers of specific safety components for quality assurance. These are targeted to those that can be inspected within the staff resources in China. However MEP (NNSA) issues registrations to a large number of manufacturers implemented in foreign countries, and seldom performs inspection of them. MEP (NNSA) relies on the conclusion of the supervision report of the operator, who performs quality assurance actions. Use of risk information tool is limited.

MEP (NNSA) has a training programme for inspectors on inspection techniques and some selected technical areas such as reactor operations and simulator training. Upon completion of the programme and development, the inspectors are required to pass an examination for certification. There is no systematic programme for training and development of experts inspectors. There is a significant increase in workload for inspection in China due to construction and planned construction for multiple new nuclear power units. Inspector resources have been approved to address the new workload, but recruiting has not brought the level of on board inspectors to that approved. Recruitment and retention of inspectors with experience is difficult in the country, due to competition with the utilities or operators of the NPPs for increased hiring of individuals. These facts create an environment where there are not sufficient inspectors to keep pace with the inspections needed for a large sample of verification of operating or construction actions. There are not sufficient numbers of experts on the staff in the headquarters of MEP (NNSA) and NSC, so there is a need to rely on external experts from other TSOs. The inspection programme and expertise in NNSA provides comprehensive direction and inspections focused on the right issues and with the right perspective on safety significance in the areas being examined, but there is a limited experience to know the areas to inspect in areas that are not described in the programme or procedures.

MEP (NNSA) has a programme for sharing information among inspectors and with NPP operators. The information includes lessons learned from events and inspection findings. The programme is very thorough within the regional office and among the inspectors at each site. There is also a planned approach to gather all the inspectors together one time per year in MEP (NNSA) Headquarters for sharing of information and feedback. There is also an annual meeting with representatives of NPPs, the Regional Offices and MEP (NNSA) Headquarters for each NPP to share information and to provide feedback in areas where the programme could be enhanced. Sharing of information between Regional Offices is limited and not as systematic as within an office. Generic issues are identified and communicated to NPPs, in response to events or specific inspection findings that may be applicable on a universal basis. Processes need to be developed to enhance international cooperation.

MEP (NNSA) managers and inspectors are timely and thorough in follow up on events and inspection findings. The approach is graded, with the most significant safety items receiving the most attention. Communication of findings is clear and open with the licensee. Inspection reports are comprehensive and include key messages on what was inspected, the safety significance, what needs to be corrected. NNSA has clear guidance to seek feedback from the licensee prior to finalizing the findings and requesting action.

While in a manufacturing plant, MEP (NNSA) combines inspections of manufacturer and the operator in charge of the supervision of the manufacturer. Then inspection of manufacturers cover both the manufacturer and the operator. MEP (NNSA) inspection reports keep separate conclusions dedicated and sent to each party.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 18: Staffing and competence of the regulatory body - §4.13 states that** *"A process shall be established to develop and maintain the necessary competence and skills of staff of the regulatory body, as an element of knowledge management. This process shall include the development of a specific training programme on the basis of an analysis of the necessary competence and skills. The training programme shall cover principles, concepts and technological aspects, as well as the procedures followed by the regulatory body for assessing applications for authorization, for inspecting facilities and activities, and for enforcing the regulatory requirements."*
(2)	**BASIS: GS-G-1.3 §3.17 states that** *"The regulatory body, including a dedicated support organization if appropriate, should have staff capable of performing the activities needed for its inspection programme or, if outside consultants are used, staff capable of adequately supervising the consultants' work and independently evaluating its quality and the results."*
S26	**Suggestion: MEP (NNSA) should enhance its training programme for inspectors and experts; the enhancement would provide knowledge and experience in all areas of safety, security, radiation protection and the environment that inspectors oversee during the lifecycle of the plant.**
GP7	**Good Practice: The MEP (NNSA) training programme for inspectors includes simplified reactor behaviour simulation training as well as licensee provided material on site equipment and systems.**
(1)	**BASIS: GSR Part 1, Requirement 15,** *Sharing of operating experience and regulatory experience,* **states that**: *"The regulatory body shall make arrangements for analysis to be carried out to identify lessons to be learned from operating experience and regulatory experience, including experience in other States, and for the dissemination of the lessons learned and their use by authorized parties, the regulatory body and other relevant*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	authorities."
R24	**Recommendation: MEP (NNSA) should enhance the process of review, analysis and sharing of operating experiences. This includes sharing of experience amongst the regions. This process should include appropriate means of sharing information amongst the regulatory body and operating organizations. The regulatory body should consider the development of a database to facilitate management of follow up actions, trending, accessing to information as part of overall knowledge management.**
S27	**Suggestion: MEP (NNSA) should formalize a mentoring programme to build expert knowledge and skills of inspectors in order to aid the inspectors in areas which are not covered by procedures. This mentoring programme should extend beyond the initial inspector certification training programme.**
(1)	**BASIS: GSR Part 1 – Requirement 29: Graded approach to inspections of facilities and activities - §4.50 states that** *"The regulatory body shall develop and implement a programme of inspection of facilities and activities to confirm compliance with regulatory requirements and with any conditions specified in the authorization. In this programme, it shall specify the types of regulatory inspection (including scheduled inspections and unannounced inspections), and shall stipulate the frequency of inspections and the areas and programmes to be inspected, in accordance with a graded approach."*
(2)	**BASIS: GSR Part 1 – Requirement 29: Graded approach to inspections of facilities and activities - §4.53 states that "***In conducting inspections, the regulatory body shall consider a number of aspects, including:* – *Structures, systems and components and materials important to safety;* – *Management systems;* – *Operational activities and procedures;* – *Records of operational activities and results of monitoring;* – *Liaison with contractors and other service providers;* – *Competence of staff;* – *Safety culture;* *Liaison with the relevant organization for joint inspections, where necessary."*
(3)	**BASIS: GS-G-1.3 §4.3 states that** *"The regulatory body shall establish a planned and systematic inspection programme. The extent to which inspection is performed in the regulatory process will depend on the potential magnitude and nature of the hazard associated with the facility or activity."*
(4)	**BASIS: GS-G-1.3 §4.4 states that** *"Regulatory inspection programmes should be comprehensive and should be developed within the overall regulatory strategy. These programmes should be thorough enough to provide a high level of confidence that operators are in compliance with the regulatory requirements and are identifying and solving all actual and potential problems in ensuring safety. The inspection programme should be developed so that the regulatory body can determine whether the operator has a functional self-assessment system of high quality and is conducting its activities in accordance with its own established*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	procedures for ensuring that regulatory objectives and requirements are met."
S28	**Suggestion: MEP (NNSA) should look for ways to enhance the sharing of detailed inspection procedures and their application amongst the regional offices, especially for new construction inspections. Detailed inspection procedures would provide guidance on what to inspect from the significance perspective to inspectors without detailed technical expertise.**
(1)	**BASIS: GSR Part 1 – Requirement 29: Graded approach to inspections of facilities and activities - §4.53 states that "***In conducting inspections, the regulatory body shall consider a number of aspects, including:* – *Structures, systems and components and materials important to safety;* – *Management systems;* – *Operational activities and procedures;* – *Records of operational activities and results of monitoring;* – *Liaison with contractors and other service providers;* – *Competence of staff;* – *Safety culture;* *Liaison with the relevant organization for joint inspections, where necessary."*
(2)	**BASIS: GS-G-1.3 §2.3 states that** *"Regulatory inspection is performed to make an independent check on the operator and the state of the facility, and to provide a high level of confidence that operators are in compliance with the safety objectives prescribed or approved by the regulatory body. This should be achieved by confirming that:* *(a) All applicable laws, regulations and licence conditions and all relevant codes, guides, specifications and practices are complied with;* *(b) The operator has a strong and effective management, good safety culture and self-assessment systems for ensuring the safety of the facility and the protection of workers, the public and the environment;* *(c) The required quality and performance are achieved and maintained in the safety related activities of the operator and in the structures, systems and components (SSCs) of the facility throughout its lifetime;* *(d) Sufficient numbers of personnel, who have the necessary competences for the efficient and safe performance of their duties, are available at all times and throughout all stages of the facility's lifetime;* *(e) Deficiencies and abnormal conditions are identified and promptly evaluated and remedied by the operator and duly reported to the regulatory body as required;* *(f) Any other safety issue that is neither specified in the authorization nor addressed in the regulation is identified and appropriately considered."*
(3)	**BASIS: GS-G-1.3 §4.14 states that** *"Before an inspection is carried out, the inspection personnel should be thoroughly prepared for the task. The type of preparation will depend on the type and method of inspection. Preparation may include a review of the following:*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	—regulatory requirements relating to the inspection area; *—past operating experience relating to the inspection area;* *—findings of previous inspections and enforcement actions relating to the inspection area;* *—past correspondence between the regulator and the operator relating to the inspection area;* *—the safety documentation and operational limits and conditions;* *—documentation on operation and design for the facility;* *—the operator's management procedures and quality assurance programme."*
S29	**Suggestion: MEP (NNSA) inspectors should consider extending the scope of review of NPPs to include how the licensee manages technical processes and programmes in detail.**
S30	**Suggestion: MEP (NNSA) should consider developing a database of inspection findings, to be shared within the entire NNSA.**
(1)	**BASIS: GSR Part 1 – Requirement 29: Graded approach to inspections of facilities and activities - §4.53 states that "***In conducting inspections, the regulatory body shall consider a number of aspects, including:* – *Structures, systems and components and materials important to safety;* – *Management systems;* – *Operational activities and procedures;* – *Records of operational activities and results of monitoring;* – *Liaison with contractors and other service providers;* – *Competence of staff;* – *Safety culture;* *Liaison with the relevant organization for joint inspections, where necessary."*
(2)	**BASIS: GS-G-1.3 §4.5 states that** *"Different methods may be used in establishing or modifying an inspection programme, with associated priorities, to achieve the objectives of regulatory inspections. The regulatory body should consider the following:* *—the results of previous inspections;* *—the safety analysis performed by the operator and the results of regulatory review and assessment;* *—performance indicator programmes or any other systematic method for the assessment of the operator's performance;* *—operational experience and lessons learned from operating the facility and other similar facilities as well as results of research and development;* *—inspection programmes of the regulatory bodies in other States."*
S31	**Suggestion: MEP (NNSA) should continuously improve and implement the programme of safety performance indicators for utilities and ensure that staffs are trained in their use.**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 – Requirement 11: Competence for safety - §2.36 states that** *"The government:* – *shall stipulate a necessary level of competence for persons with responsibilities in relation to the safety of facilities and activities;* – *shall make provision for adequate arrangements for the regulatory body and its support organizations to build and maintain expertise in the disciplines necessary for discharging the regulatory body's responsibilities in relation to safety;* – *shall make provision for adequate arrangements for building, maintaining and regularly verifying the technical competence of persons working for authorized parties."*
S32	**Suggestion: MEP (NNSA) should consider optimizing the practice of rotating resident inspectors among sites to allow sufficient time at one site in order to stabilize the experience level but not too long to suffer regulatory capture.**
(1)	**BASIS: GSR Part 1 – Requirement 11: Competence for safety - §2.36 states that** *"The government:* – *shall stipulate a necessary level of competence for persons with responsibilities in relation to the safety of facilities and activities;* – *shall make provision for adequate arrangements for the regulatory body and its support organizations to build and maintain expertise in the disciplines necessary for discharging the regulatory body's responsibilities in relation to safety;* – *shall make provision for adequate arrangements for building, maintaining and regularly verifying the technical competence of persons working for authorized parties."*
(2)	**BASIS: GS-G-1.3 §4.8, states that** *"Arrangements should be made to ensure that all relevant staff of the regulatory body can fully contribute to the planning of inspections and in particular, if the offices of the regulatory body are distributed over a wide area, that resident inspectors are involved in the planning process. This will ensure the best use of the skills and knowledge of its staff."*
(3)	**BASIS: GS-G-1.3 §4.14 states that** *"Before an inspection is carried out, the inspection personnel should be thoroughly prepared for the task. The type of preparation will depend on the type and method of inspection. Preparation may include a review of the following:* *—regulatory requirements relating to the inspection area;* *—past operating experience relating to the inspection area;* *—findings of previous inspections and enforcement actions relating to the inspection area;* *—past correspondence between the regulator and the operator relating to the inspection area;* *—the safety documentation and operational limits and conditions;* *—documentation on operation and design for the facility;* *—the operator's management procedures and quality assurance programme."*
S33	**Suggestion: MEP (NNSA) should consider using technical support organizations**

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	consistently to contribute to the development of site specific inspection guides.

MEP (NNSA) issues registrations to manufacturers from foreign countries. MEP (NNSA) seldom inspects manufacturers and relies on the supervision report of the related operator in order to ensure that the license can be maintained.

Each imported component from a foreign manufacturer undergoes a safety check when entering the Chinese territory.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR-part1 Requirement 27 states that**: The regulatory body shall carry out inspections of facilities and activities to verify that the authorized party is in compliance with the regulatory requirements and with the conditions specified in the authorization.
R25	**Recommendation: MEP (NNSA) should strengthen the auditing programme in foreign factories for quality assurance of equipment to be used in Chinese NPPs.**

To face the very high demand for human resources with appropriate skills in the frame of operation of NPPs, MEP (NNSA) uses the help of different units of the administration (NSC, other ministry etc. …).

Experienced staff from utilities can also be hired by MEP (NNSA) for a period not exceeding 2 years. These staff previously belonged to the nuclear safety office of the utility so they are well versed in regulatory functions. Even though they are not used to assess their own utilities, they are still paid by them.

MEP (NNSA) stated an example where a non conformance, detected during the manufacturing of a part of a steam generator, led to an enforcement action.

In that case, other operators from foreign countries are customers of the manufacturer involved. MEP (NNSA) informed other regulatory bodies (South Korea, France) through bilateral annual meetings.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 Requirement 15: Sharing of operating experience and regulatory experience §3.4 states that** "*The regulatory body shall establish and maintain a means for receiving information from other States and from authorized parties and a means for making available to others lessons learned from operating experience and regulatory experience. The regulatory body shall require appropriate corrective actions to be carried out to prevent the recurrence of safety significant events. This process involves acquisition of the necessary information and its analysis to facilitate the effective utilization of international networks for learning from operating experience and regulatory experience.*"
S34	**Suggestion: MEP (NNSA) should consider enhancing the sharing of major lessons learned from manufacturing experience with others.**
GP8	**Good Practice: MEP (NNSA) has initiated periodic meetings between Chinese manufacturers to promote the exchange of important manufacturing information**.

7.2. FUEL CYCLE FACILITIES

Operational experience feedback is an important aspect of enhancing safety during the operation of nuclear facilities. Operational experience compliments initial authorization for operation as well as should

be applied during the design of new facilities. Within the regulatory framework of the PRC, fuel cycle facilities are required to report operational occurrences to MEP (NNSA). MEP (NNSA) arranges biannual meetings of fuel cycle facilities at which operational experience is discussed. However, there is no formal programme within MEP (NNSA) headquarters to assess these event reports and share these events amongst the regional offices and other fuel cycle facilities. In interviews with MEP (NNSA) regional office personnel, they would periodically receive information on operational events, but there was no procedures governing this activity. In addition, there was no type of database in which the operational data was collected.

The lack of formal procedure and infrastructure related to MEP (NNSA) review and assessment of operational event prohibit the use and benefit of operational experience.

Members of the IRRS Review Team had the opportunity to witness an inspection held in one of the fuel cycle facilities. It became apparent via interviews and observations that the inspection was following a well elaborated, detailed inspection plan that considered every important aspects of the operation and management of a fuel cycle facility.

The detailed and elaborated inspection plan has largely contributed to an effective and efficient inspection of the facility.

7.4. INDUSTRIAL, MEDICAL AND RESEARCH FACILITIES

Inspections are conducted by the relevant authorities, i.e. NNSA, its regional offices or the Provincial Environmental Protection Administration Bureau (provincial EPB). The MOH or the provincial heath authorities conduct inspections relating to the medical uses of radiation, as well as, occupational exposure control in all practices, these two inspections seem to partly address common issues.

The MEP (NNSA) supervises the inspection process in order to ensure consistency of the inspections conducted by the six Regional Offices. Measures to this effect include the use of consistent checklists and annual reporting of inspection activities to the MEP (NNSA). In addition, the MEP (NNSA) visits the headquarters of the provincial EPB annually and conducts random inspection to facilities regulated by the provincial EPB.

Inspection frequencies are set in accordance with a graded approach depending on the category of the sources in the facility or activity. For category I sources, inspection frequencies vary from four inspections per year to one inspection per year, depending on the type of the practice. For category II to V sources, provincial EPBs and provincial DoH, as applicable, conduct inspections at least once per year irrespective of the source category.

Inspection frequencies may vary depending on the performance of the facility or activity.

During the site visits the IRRS Review Team observed that past inspection findings were followed up and corrected. The inspectors used detailed practice specific checklists which they followed soundly throughout the inspections. However, the IRRS Review Team also noticed that conducting an inspection based on a detailed checklist could potentially diminish inspectors' consciousness to matters not necessarily covered by the checklists. For example, the IRRS Review Team observed in site-visits that some matters related, e.g. for classification of working area were not fully addressed during the inspection.

In general, the IRRS Review Team considered that the inspections were thorough and were conducted in a professional manner.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 18: Staffing and competence of the regulatory body states that** *"The regulatory body shall employ a sufficient number of qualified and competent staff, commensurate with the nature and the number of facilities and activities to be regulated, to perform its functions and to discharge its responsibilities."*
(2)	**BASIS: GSR Part 1 - Requirement 18: Staffing and competence of the regulatory body - §4.13 states that** *"A process shall be established to develop and maintain the necessary competence and skills of staff of the regulatory body, as an element of knowledge management. This process shall include the development of a specific training programme on the basis of an analysis of the necessary competence and skills. The training programme shall cover principles, concepts and technological aspects, as well as the procedures followed by the regulatory body for assessing applications for authorization, for inspecting facilities and activities, and for enforcing the regulatory requirements."*
S35	**Suggestion: The regulatory body should ensure that the inspectors' competencies and inspection procedures are enhanced so that they recognize matters related to radiation safety and regulatory requirements if not included in their inspection checklists.**
(1)	**BASIS: GSR Part I, Requirement 29 states that** *"Inspections of facilities and activities shall be commensurate with the radiation risks associated with the facility or activity, in accordance with a graded approach."*
S36	**Suggestion: The regulatory body should consider optimizing the implementation of the graded approach by adjusting the inspection frequencies and process according to the category of the sources.**

7.5. WASTE FACILITIES

MEP (NNSA) has implemented a systematic inspection programme for the Beilong disposal facility that follows a graded approach. The annual inspection at Beilong was announced in advance, on July 14, 2010. The majority of the inspection activities performed by MEP (NNSA) inspectors are announced inspections, however, the programme does provide for the option of conducting unannounced inspections. The inspection team consisted of representatives of MEP (NNSA) headquarters, MEP (NNSA) Guangdong regional office, and NSC. The operator of the disposal facility is the Guangdong Daya Bay Nuclear Power Environment Protection Co. Ltd.

The inspection team carried out the following activities:

- Reviewed the findings of the previous inspection;
- Examined various records of the operator;
- Inspected the disposal vaults and underground galleries;
- Convened a meeting of the inspection team to formulate findings; and
- Held exit meeting.

The inspection report is planned to be delivered to the operator within a period of two weeks. The operator then has to respond to the inspection findings within two months.

The IRRS Review Team inspected records of waste receipt and found that the facility operator does not:

1) maintain a cumulative total of the nuclide-specific inventory in the disposal vaults; and

2) does not specify on records of waste receipt many of the important non-radiological parameters for the waste (e.g., toxic metals).

Before entering the controlled area of the site (where the disposal vaults are located), the inspection team was provided with protective clothing and personal dosimeters. Upon exiting the controlled area, there was essentially no personnel contamination monitoring (e.g., no hand-foot contamination monitor).

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 5 - Requirement 3: Responsibilities of the regulatory body §3.8 states that** "To facilitate compliance with regulatory requirements, the regulatory body has to do the following:….. *—Ensure that due consideration is given to non-radiological hazards throughout the entire predisposal management of radioactive waste."*
(2)	**BASIS: SSR Part 5 §2.24 states that** *"The impact of non-radioactive materials present in a disposal facility have to be assessed in accordance with national or other specific regulations, and this may be significant in some cases e.g. for some mining wastes and mixtures of radioactive waste and toxic wastes. If non-radioactive materials may affect the release and migration of radioactive contaminants from the radioactive waste, then such interactions have to be considered in the safety assessment."*
(3)	**BASIS: SSR Part 5 - Requirement 18: Operation of a disposal facility - §4.35 states that** "*All operations and activities important to the safety of a disposal facility have to be subjected to limitations and controls and emergency plans have to be put in place. The various procedures and plans have to be documented and the documentation has to be subject to appropriate control procedures [19]. The safety case has to address and justify both the design and operational management arrangements that are used to ensure that the safety objective and criteria set out in Section 2 are met. Additional, facility specific criteria may be established by the regulatory body or by the operator."*
R26	**Recommendation: The regulatory body should ensure that due consideration is given to certain parameters and properties of waste which the operator does not appear to be reporting, namely:** **- a cumulative total of the nuclide specific inventory of the disposal facility,** **- important non-radiological properties of the waste.**
(1)	**BASIS: International Basic Safety Standard §I.23 states that "***Registrants and licensees shall:…(g) provide, as appropriate, at exits from controlled areas:* *(i) equipment for monitoring for contamination of skin and clothing;* *(ii) equipment for monitoring for contamination of any object or substance being removed from the area;* *(iii) washing or showering facilities; and* *(iv) suitable storage for contaminated protective clothing and equipment;"*
R27	**Recommendation: The regulatory body should require the operator to strengthen their programme for radiation protection monitoring of the controlled area at the Beilong disposal facility.**

8. ENFORCEMENT

8.1. NUCLEAR POWER PLANTS

NNSA has a strong enforcement programme, defined in the law. Responsibilities and authorities are well laid out throughout the organization into lower level documents, such as the Inspection Programme documents for each site. The regulatory documents define the authority to issue types of enforcement actions, follow up and closure of enforcement. MEP (NNSA) uses a team, consensus process to review and determine the most appropriate enforcement action. Inspection findings, including enforcement are provided to licensees in writing after a thorough review by the inspectors and managers involved and after discussions with the affected licensee. The system allows the licensee's perspective and views to be heard by MEP (NNSA) during all steps of the process. MEP (NNSA) has evaluated the generic implications of findings and distributed the resultant enforcement actions to other nuclear power plant organizations as a tool for prevention of similar violations at those facilities. The enforcement system in MEP (NNSA) provides several options for enforcement, based in writing, on the significance of the non-conformance (i.e., a graded approach). The basis for the significance of the actions is clear. The options include issuing of violations, penalties, and the authority to shut down the operation of a nuclear power plant if the situation warrants.

The enforcement process was also assessed through the example of the event occurred in a heavy industry company where a non conformance had been detected during the manufacturing of a part of a steam generator.

MEP (NNSA) follows up thoroughly on corrective actions for enforcement for findings from events or inspections.

8.2. INDUSTRIAL, MEDICAL AND RESEARCH FACILITIES

The legal basis for enforcement of regulatory requirements related to radiation safety within China is set up primarily in the Law of the People's Republic of China on Radioactive Pollution Prevention and Control 2003 and the Regulations on the Safety and Protection of Radioisotopes and Devices Emitting Radioactive Rays (the State Council Order No.449) issued in 2005.

The enforcement options that can be applied for non-compliance include but are not limited to:

- orders to correct non-compliance;
- revoke or suspend a license;
- issue fines; and
- confiscating sources.

Severe violations may be prosecuted in the courts. It is understood that this must be done through the government public security authorities.

The enforcement actions specified in regulations no. 449 are classified according to the nature and of the offences, but not according to the associated radiation risk.

The IRRS Review Team was advised that MEP (NNSA) is currently preparing an internal guidance on enforcement policy to ensure consistent application of the various enforcement measures.

There does not appear to be published summaries of non-compliances, enforcement actions, prosecutions commenced, or convictions recorded.

Authorities comprising the regulatory body are empowered to take enforcement actions for non-compliance, and have the power to stop operations on-site if significant non-compliance or imminent hazard is detected or in an emergency. During inspection, an inspector can impose such measure after oral

confirmation from his head quarter. A written order confirming the actions taken will be sent to the facility subsequently.

Enforcement appears to be divided in accordance with regulatory responsibilities. In areas where overlap in regulatory responsibilities exists among the various authorities that collectively make up the regulatory body, potential exists for inconsistency in enforcement actions.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS*:* GSR Part 1 - Requirement 35 states that** *"The regulatory body shall make provision for establishing, maintaining and retrieving adequate records relating to the safety of facilities and activities."*
(2)	**BASIS: GSR Part I, req. 15 "Requirement 15 states that** *"The regulatory body shall make arrangements for analysis to be carried out to identify lessons to be learned from operating experience and regulatory experience, including experience in other States, and for the dissemination of the lessons learned and their use by authorized parties, the regulatory body and other relevant authorities."*
R28	**Recommendation: Periodically the regulatory body should collect, analyse and disseminate information on non-compliances and enforcement actions, in particular to provide feedback to enhance the performance of the regulatory functions.**
(1)	**BASIS*:* GS-R-1 Requirement 30 states that** *"The regulatory body shall establish and implement an enforcement policy within the legal framework for responding to non-compliance by authorized parties with regulatory requirements or with any conditions specified in the authorization."*
R29	**Recommendation: Consideration should be given for the involvement of all authorities comprising the regulatory body in the completion of the enforcement guide.**
(1)	**BASIS: GSR Part I – para 4.54 states that "***The response of the regulatory body to non-compliances with regulatory requirements or with any conditions specified in the authorization shall be commensurate with the significance for safety of the non-compliance, in accordance with a graded approach. "*
S37	**Suggestion: Consideration should be given to include risk-based grading in the implementation of the enforcement policy for radioactive sources.**

9. REGULATIONS AND GUIDES

9.1. NUCLEAR POWER PLANTS

9.1.1. Legislation and Regulations

China has established its regulations concerning nuclear and radiation safety largely by adopting and adapting IAEA safety standards. The Chinese legislation and regulations cover nuclear power plants, research reactors, fuel cycle facilities, facilities on radioactive waste treatment and disposal, nuclear safety equipment, nuclear technology applications, uranium (thorium) mining and associated mineral resources exploitation and application, etc. This provides a legislative basis for civil nuclear installations starting from selection of site, through design, construction, commissioning and operation, to decommissioning. China is committed to improve its regulatory system on the nuclear and radiation safety by reflecting domestic experiences combined with the latest international practices.

The regulations system for Chinese nuclear and radiation safety is structured as a five level framework: the Act from the People's Congress, Administrative Regulations from the State Council, Department Rules, Safety Guides, and Technical Documents. The Act, Administrative Regulations, and Department Rules including Compulsory National Standards are mandatory. Compulsory National Standards are technical requirements approved and issued by the Standard Administration of the People's Republic of China. Safety Guides are recommendatory. Technical Documents promulgated by relevant departments of the State Council or their entrusted industrial organizations are referential.

The hierarchy and structure of the Chinese nuclear and radiation safety regulations and guides is considered to be generally consistent with international practices.

9.1.2. Existing Regulations and Guides

Currently, there exists one Act (Act on Radioactive Pollution Prevention and Control of the People's Republic of China) and relevant Acts (Act on Administrative Licence of the People's Republic of China, Act on Environmental Protection of the People's Republic of China, Act on Environmental Impact Assessment of the People's Republic of China, etc.). The Act on Atomic Energy of the People's Republic of China has been delayed after first draft due to administrative processes requiring consensus among participating organizations. As the Act provides the legal basis by specifying basic safety principles, licensing system and functions and role of different organizations related to nuclear regulation, it should be issued as soon as possible.

Regulations specify regulatory scope, regulators and their functions, principles and procedures. Currently, there exist six regulations (Regulations on Safety Regulation for Civilian Nuclear Installations of the People's Republic of China, Regulations on the Nuclear Materials Control of the People's Republic of China, Regulations on Emergency Management for Nuclear Accidents at Nuclear Power Plants, Regulations on Safety and Protection of Radioactive Isotope and Radioactive Ray Emitting Devices, Regulations on Supervision and Control of Civil Nuclear Safety Equipment, Regulations on Transportation Safety for Radioactive Substances). Among the above Regulations, the Regulations on Supervision and Control of Civil Nuclear Safety Equipment was enacted in the beginning 2008. This measure was taken by Chinese government to control and manage civil safety equipment supplied to its nuclear facilities. It requires foreign nuclear equipment suppliers to get registration from the MEP (NNSA).

Departmental Rules are implementation rules, based on the articles of Nuclear Safety Regulations, prescribing the approach in details. Currently, a total of 25 major departmental rules exist: general rules (10), nuclear power plants (4), research reactors (2), nuclear fuel cycle facility (1), radioactive waste management (1), nuclear material regulation (1), civilian nuclear safety equipment regulation (4),

radioactive isotopes and radiation apparatuses regulation (1), radiation environment (1). Besides, there are 9 other regulatory documents pertaining to Departmental Rules.

Safety Guides elaborate or supplement nuclear safety regulations to prescribe approaches and procedures. Currently, a total of 81 Safety Guides exists: general safety guides (17), nuclear power plants (41), research reactors (5), nuclear fuel cycle facilities (4), radioactive waste management (7), and nuclear material regulation (7).

Technical Documents are references to nuclear and radiation safety technologies including some translated IAEA documents. Currently, there are more than 180 Technical Documents available.

Some relevant Departments of the State Council or their entrusted organizations formulate also the above mentioned documents according to the authorization of corresponding laws and regulations.

9.1.3. Process to develop regulations and the amendment programme

In the MEP (NNSA) there is a Department of Policies, Laws and Regulations which coordinates the activities related to the development of regulations. In the Department of Nuclear Safety the Division of General Affairs is in charge of development of regulations. The actual writing of regulations takes place in the NSC and they have a Division of Regulations to coordinate this work.

There are several steps in the process to develop regulations. After the internal review two review meetings are arranged with the Subcommittee of the Committee of Reviewing Regulations and Standards on Nuclear and Radiation Safety ("Regulations Committee") and one review meeting with the full Committee. The review meetings may take three to four days. Comments from utilities are asked once or twice between the review meetings. After approval of the Regulations Committee, the Department Rules and the Safety Guides and Technical Documents are issued by the MEP (NNSA). The preparation process is well established. Up to now, more than 25 documents have been produced this way during the last two years.

The MEP (NNSA) have operated the Regulations Committee for two years now. The purpose is to provide the expert opinion concerning the system of the regulations and standards, and to propose suggestions and advice on the regulations and guides. The committee consists of four experts groups (subcommittees): nuclear safety, radiation safety, nuclear safety equipment, and electromagnetic radiation. A total of around 100 members are engaged. Experts from the NSC act as secretaries of the Committee and its subcommittees. The role of the MEP (NNSA) seems to be just administrative.

The requirements in the new regulations become effective at the same time as the regulations are issued without any transition period. The licensees are not required to assess whether their facility and activities comply with these new requirements. In addition to the yearly plans the MEP (NNSA) has formulated a five year amendment programme (2010-2015) for the framework of nuclear and radiation safety regulations. Under the programme, the MEP (NNSA) will promote one Act (Act on Atomic Energy or Act on Nuclear Safety of the People's Republic of China) and one Regulation (Electromagnetic Environmental Protection), and promulgate one Regulation (Safety Management of Radioactive Waste), 16 Departmental Rules, and 104 Safety Guides. The MEP (NNSA) will revise several Safety Guides in the areas of Civilian Nuclear Safety Equipment Supervision, Radioactive Material Transportation, Supervision of Radioactive Isotopes and Ray Apparatuses, and Radiation Environment, etc.

In spite of the amendment programme prepared, there will still remain several Departmental Rules and Safety Guides not revised for more than 15 years. The MEP (NNSA) should make a plan to revise the outdated regulations and guides in a proper time interval.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 20: Liaison with advisory bodies and support organizations states that** *"The regulatory body shall obtain technical or other expert professional advice or services as necessary in support of its regulatory functions, but this shall not relieve the regulatory body of its assigned responsibilities."*
(2)	**BASIS: GSR Part 1 - Requirement 33: Review of regulations and guides states that** *"Regulations and guides shall be reviewed and revised as necessary to keep them up to date, with due consideration of relevant international safety standards and technical standards and of relevant experience gained."*
R30	**Recommendation: The MEP (NNSA) should adopt a practice where all the regulations are reviewed on a regular basis.**
S38	**Suggestion: The MEP (NNSA) should allocate sufficient resources and funding to the development of regulations and guides.**

9.1.4. Application of Regulation and Guides

Applicable regulations and guides issued by the regulatory authorities shall be implemented in the design of nuclear facilities. For the regulatory review of certain designs, the MEP (NNSA) stipulate some Evaluation Principles: e.g. the Evaluation Principles of the Nuclear Safety for Generation II Improved Nuclear Power Plant Project and the Evaluation Principles of the Nuclear Safety for High Temperature Gas Cooled Reactor Nuclear Power Plant Demonstration Project etc.. These evaluation principles are not part of the official regulations and they are not published.

This approach is inevitable for such new reactor types to which existing regulations could not be applied. However, in some cases the application of this kind of evaluation principles may relieve the strict requirements of the regulations. Especially for Generation II reactors, the MEP (NNSA) should evaluate the impact on safety caused by the differences between the evaluation principles and the existing regulations.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part 1 - Requirement 25: Review and assessment of information relevant to safety that** *"The regulatory body shall review and assess relevant information — whether submitted by the authorized party or the vendor, compiled by the regulatory body, or obtained from elsewhere — to determine whether facilities and activities comply with regulatory requirements and the conditions specified in the authorization. This review and assessment of information shall be performed prior to authorization and again over the lifetime of the facility or the duration of the activity, as specified in regulations promulgated by the regulatory body or in the authorization."*
(2)	**BASIS: GSR Part 1 - Requirement 32: Regulations and guides states that** *"The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based."*
R31	**Recommendation: The MEP (NNSA) should follow a policy where, in the long run, the licensing of new nuclear power plants is based on existing regulations. The need to backfit operating plants to meet the regulations should be assessed first as new regulations are**

issued and then in connection with Periodic Safety Reviews. Backfitting concerning operating plants should be performed, based on these assessments, as found reasonably practicable.

9.2. RESEARCH REACTORS

In many cases, requirements as suggested by NS-R-4 do not appear in any legally binding regulations, but are formulated in regulatory guides or in technical documents. In other cases, requirements exist for nuclear power plants and are tacitly understood to be applicable to research reactors. Certain suggested requirements, although are conformed with in practice, are entirely missing from the regulations. Selected cases identified by the IRRS Review Team from the self-assessment report and through interviews with the MEP (NNSA) staff are given below:

1. The overall responsibility of the operating organization as the organization and the reactor manager as the person for safety and safe operation, respectively, is one of the most important safety principles. The former appears in a regulation; the latter, however, is formulated in a regulatory guide only;
2. Procedures for inspection, testing and maintenance of systems important for safety are not required in any regulation although are mentioned in a regulatory guide. Furthermore regular review of such procedures is not required in any regulation or guide;
3. Actions to be taken in connection with ageing management of research reactors are described in a regulatory technical document; no regulatory requirements exist in the subject;
4. Decommissioning (dismantling) of experimental devices of research reactors is not foreseen in any regulatory requirement. A guide describes certain details of the related regulatory expectations;
5. Use of computerized systems in systems and instruments important for safety of research reactors and critical assemblies is the result of recent developments. No related regulations specific to research reactors exist instead those developed for nuclear power plants are referred to;
6. Storage of spent fuel elements is an issue to be considered from the very beginning of the construction of a research reactor. Nonetheless, there are no requirements in the valid regulations for provisions of storage of spent fuel in the design of a research reactor;
7. NS-R-4 requires that the OLC of a research reactor needs to include requirements on organizational structure and responsibilities of the operator. A regulatory code mentions this as a possibility, but not as a requirement. Interviews with the MEP (NNSA) staff revealed that such a requirement exists for nuclear power plants and in practice is also applied to larger research reactors, whereas for smaller reactors OLC does not contain details on organization and responsibilities;
8. For the safe operation of the reactor the operator shall keep records of any information related to safety. Among others records on non-compliances are to be prepared and retained. In case of research reactors no such obligation of the operator is required by the regulation, it is assumed that respective regulations on nuclear power plant apply; and
9. Monitoring and signaling of parameters having safety limits is of primary importance in the safe operation of a research reactor. Nevertheless apparently no requirements requiring monitoring and signaling of such parameters exist in the regulations.

The self-assessment report often refers to a Department Rule “Code on the Safety of Nuclear Research Reactors” as being under revision, which fully covers issues related to research reactors. Approval of this

revised rule is still pending. In the interviews with MEP (NNSA) staff, the IRRS Review Team was informed that the issuance of the Department Rule is hindered by the fact that IAEA guidance so far published in the matter is not sufficient for MEP (NNSA) to publish its own guides.

In a number of cases no legally binding documents exist to regulate research reactors and critical assemblies even if practice conforms to the required regulations; sometimes guides and/or NPP regulations address the issue. Delay in the issuance of the Department Rule and of compilation of the related guides is also an issue.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-4, §4.5 states that**: *"The establishment, management, performance and evaluation of a quality assurance programme for a research reactor and its associated experiments are important for ensuring safety. The operating organization shall establish and implement performance based quality assurance requirements for research reactors for the stages of site evaluation, design, construction, commissioning, operation, utilization, modification and decommissioning."*
(2)	**BASIS: NS-R-4, §4.6 states that**: *"The operating organization shall develop quality assurance programmes for all the stages in the lifetime of a research reactor at a time consistent with the schedule for accomplishing stage related activities. In particular, activities for site investigation, which are usually initiated long before the establishment of a project, shall be covered by a quality assurance programme."*
(3)	**BASIS: NS-R-4, §7.2 states that**: *"The operating organization shall have the overall responsibility for the safety of the research reactor, which shall not be delegated. The reactor manager shall have the direct responsibility and the necessary authority for the safe operation of the research reactor."*
(4)	**BASIS: NS-R-4, §7.57 states that**: *"All inspection, periodic testing and maintenance of systems or items important to safety shall be performed by following approved, written procedures. The procedures shall specify the measures to be taken for any changes from the normal reactor configuration and shall include provisions for the restoration of the normal configuration on the completion of the activity. A system of work permits in accordance with the quality assurance requirements shall be used for inspection, periodic testing and maintenance, including appropriate procedures for checking off before and after the conduct of the work. These procedures shall include acceptance criteria. There shall be a clearly defined structure of review and approval for the performance of the work."*
(5)	**BASIS: NS-R-4, §7.109 states that**: *"The programme of periodic review should cover aspects of the programme for the management of ageing to demonstrate the status of the facility with regard to ageing and to provide a basis for taking actions in relation to ageing. Thus, periodic reviews are operational tools to prevent and mitigate the effects of ageing and of modifications made around the site. Reviews of reactor SSCs carried out by using non-destructive techniques are called in-service inspections. In-service inspections shall be conducted by the operating organization under its programme for the management of ageing"*
(6)	**BASIS: NS-R-4, §8.8 states that**: *"Procedures for the handling, dismantling and disposal of experimental devices and other irradiated equipment that require storage and eventual disposal shall be established in advance, or as early as possible if the equipment concerned has already been constructed and these procedures are not in place."*
(7)	**BASIS: NS-R-4, §6.138 states that**: *"If the design is such that a system important to safety is dependent upon the reliable performance of a computer based system, appropriate standards*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	and practices for the development and testing of computer hardware and software shall be established and adopted throughout the lifetime of the system. For computer based digital instrumentation and control systems, verification, validation and testing of software shall be provided."
(8)	**BASIS: NS-R-4, §6.150 states that**: "*The design shall include provisions for storing a sufficient number of spent fuel elements."*
(9)	**BASIS: NS-R-4, §7.38 states that**: "*The OLCs shall include administrative requirements or controls concerning organizational structure and the responsibilities for key positions in the safe operation of the reactor, staffing…"*
(10)	**BASIS: NS-R-4, §7.83 states that** "*Records of non-compliance and the measures taken to return the research reactor to compliance shall be prepared and retained and shall be made available to the regulatory body. The operating organization shall specify the records to be retained and their retention periods."*
(11)	**BASIS: NS-R-4, §7.34 states that** "*For each parameter for which a safety limit is required and for other important safety related parameters, there shall be a system that monitors the parameter and provides a signal that can be utilized in an automatic mode to prevent that parameter from exceeding the set limit."*
R32	**Recommendation: MEP (NNSA) should revise its regulations on research reactors and critical assemblies in order to formulate requirements in compliance with the IAEA safety requirements in NS-R-4 where they exist and as far as reasonably practicable.**
S39	**Suggestion: In order to facilitate the issuance and application of the Department Rule under revision MEP (NNSA) should initiate the elaboration of related regulatory guides without waiting for issuance of the IAEA guidance.**

9.3. FUEL CYCLE FACILITIES

In many cases, requirements as suggested by NS-R-5 do not appear in any legally binding regulations, but are formulated in regulatory guides or in technical documents. In other cases, requirements exist for nuclear power plants and are tacitly understood to be applicable to fuel cycle facilities. Certain suggested requirements, although implemented in practice, are entirely missing from the regulations. Selected cases identified by the IRRS Review Team from the self-assessment report and through interviews with the MEP (NNSA) staff are given below.

1. Elaboration of design criteria including identification of levels of availability and reliability for SSCs important to safety is fundamental to the design, construction, and safety operation of a fuel cycle facility. The design criteria may be in the form of relevant codes and standards or standard engineering practices. For the PRC, these design criteria are provided in a regulatory guide having no legally binding force. Furthermore, there are no explicitly identified levels of availability or reliability for the SSCs outside of those provided within the identified codes, standards or standard practices;
2. Human factors are an important aspect of fuel cycle facilities as the operators have relatively greater access to the process operations. NS-R-5, places importance on development of human factors and man-machine interface as well as the design of the facility to minimize demands on the operator during normal operations and anticipated operational occurrences and accident conditions. Furthermore, the design should include control devices to prevent anticipated human

errors from occurring. The PRC does not have existing regulations to address the recommended IAEA safety standards;

3. Use of computerized systems important to safety in fuel cycle facilities is the result of recent developments. No related provisions specific to fuel cycle facilities are specified in the current department rule;
4. In the case of regulations related to the design of the facility to consider accident conditions, the recommendations in IAEA safety standards address consideration of the principle of independence between and within important to safety SSCs. Also addressed in the section on accident conditions is that that the loss of or excess process reagents and dilution of gases is addressed in the safety assessment. Through interviews with representatives from MEP (NNSA), it became clear that the existing regulations were issued prior to the introduction of principles such as independence and the regulations do not address consideration of process reagents in the safety analysis report; and
5. There are a number of recommendations within NS-R-5 related to the operation of the facility which are performed in practice but do not have corresponding requirements. These have to do with evaluation of significant deviations from operating instructions; control of equipment used for maintenance, calibration and periodic testing are properly controlled to ensure their function; proper attention to subordinate activities; and operation of the facility to prevent criticality. Collectively, adherence to these recommendations contributes to safe operation of the facility. During interviews with MEP (NNSA) the IRRS Review Team has learned that there are national standards on criticality, just not this specific provision.

In a number of cases no legally binding documents exist to regulate fuel cycle facilities even if practice conforms to the required regulations; sometimes guides and/or NPP regulations address the issue.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: NS-R-5, §6.11 states that** "*Design criteria for all relevant parameters shall be specified for each operational state of the facility and for each design basis accident or equivalent. Design criteria for SSCs important to safety may be in the form of engineering design rules. Engineering design rules include requirements in relevant codes and standards and may be set and required explicitly by the regulatory body by requiring the use of applicable standard engineering practices already established in the State or used internationally. Design rules shall provide for safety margins[9] over and above those foreseen for operations to provide reasonable assurance that no significant consequences would occur even if the operational limits were exceeded within the safety margin.* [9]*A safety margin is the difference between a safety limit and an operational limit."*
(2)	**BASIS: NS-R-5, §6.13 states that** "*The operating organization shall ensure that the necessary levels of availability and reliability of SSCs important to safety, as established in the licensing documentation, are attained. The design principles stated in Annex II shall be applied as appropriate to achieve the required availability and reliability of SSCs important to safety in operational states and in accident conditions."*
(3)	**BASIS: NS-R-5, §6.15 states that** "*Human factors and human–machine interfaces shall be considered throughout the design process. Human factors are an important aspect of the safety of fuel cycle facilities as the state of the process changes frequently and operators have relatively greater access to the process operations. Ergonomic principles shall be applied in the design of control rooms and panels. Operators shall be provided with clear displays and audible signals for those parameters that are important to safety.*"

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(4)	**BASIS: NS-R-5, §6.16 states that** "*The design shall minimize the demands on operators in normal operations and in anticipated operational occurrences and accident conditions, for example through automating appropriate actions to promote the success of the operation. The need for appropriate control devices (e.g. interlocks, keys, passwords) to anticipate foreseeable human errors shall be taken into account in the design.*"
(5)	**BASIS: NS-R-5, §6.20 states that** "*If a computer based system is important to safety or forms part of a system important to safety, appropriate standards and practices for the development and testing of computer hardware and software shall be established and shall be implemented throughout the lifetime of the system, in particular at the software development stage. The entire development shall be subject to an appropriate management system. The level of reliability necessary shall be commensurate with the importance of the system to safety [18].*"
(6)	**BASIS: NS-R-5, §6.27 states that** "*The principle of independence (see Annex II) shall be specifically addressed with respect to the segregation for purposes of operational control between SSCs important to safety and also within SSCs important to safety as appropriate.*"
(7)	**BASIS: NS-R-5, §6.29 states that** "*The loss or excess of process reagents and diluent gases shall be considered during the safety assessment."*
(8)	**BASIS: NS-R-5, §9.25 states that** "*Arrangements shall be made to ensure that significant deviations from operating instructions are identified, and, where appropriate, an investigation is carried out into the cause and appropriate actions are taken to prevent recurrence. Such arrangements shall include notification to the regulatory body if the deviations result in the breach of an operational limit or condition."*
(9)	**BASIS: NS-R-5, §9.31 states that** "*Equipment and items used for maintenance, calibration, periodic testing and inspection shall be identified and controlled to ensure their proper use."*
(10)	**BASIS: NS-R-5, §9.34 states that** "*Special attention shall be paid to subordinate operations such as decontamination, washing and preparation for maintenance or testing, as there are many occurrences at facilities while such operations are taking place."*
(11)	**BASIS: NS-R-5, §9.49 states that** "*All operations with fissile material shall be performed in such a way as to prevent a criticality accident."*
R33	**Recommendation: MEP (NNSA) should revise its regulations on fuel cycle facilities in order to formulate requirements in compliance with the IAEA safety requirements in NS-R-5 where they exist and as far as are reasonably practicable.**
S40	**Suggestion: In order to facilitate the issuance and application of any such revision to regulations, MEP (NNSA) should initiate the elaboration of related regulatory guides.**

9.4. INDUSTRIAL, MEDICAL AND RESEARCH FACILITIES

The overall legislation system for the control of radiation sources comprises a hierarchy of laws, regulations, guidelines and standards. The legislative system is described in more detail in Chapter 1.

The Law of the People's Republic of China on Radioactive Pollution Prevention and Control (2003) is the primary law for the regulation of radiation sources. Regulatory requirements regarding radiation sources have been set in the Regulations on the Safety and Protection of Radioisotopes and Devices (State Council Regulations no. 449, 2005) and in the mandatory Basic Safety Standards on Ionizing Radiation Protection and Radiation Sources (GB18871-2002).

In addition, medical uses of radiation are subject to the requirements of the No 46 Rule on the Administration of Radiodiagnosis and Radiotherapy (Ministry of Health, 2006). The use of radiopharmaceuticals is regulated subject to additional requirements set in the States Councils Order No 5 (1989).

Regulations are generally issued at a higher admin level (State Council), to be implemented by various authorities in accordance with their respective regulatory scope.

Both ministries, MEP and MOH have issued a set of guides relating to the radiation safety.

The regulations no. 449 provide for the graded approach in the implementation of regulatory requirements. This graded approach is based on categorization of radiation sources according to the associated risks. For sealed sources, the categorization scheme is derived from IAEA categorization of sources. Additionally, MEP (NNSA) adopted categorization for unsealed sources as well as for radiation-emitting devices.

The IRRS Review Team was informed that the Chinese BSS is essentially the same as the International Basic Safety Standards. In general, the set of legislation, regulations, guides and standards seem to be consistent with the IAEA Safety Standards.

The IRRS Review Team was informed that additional guides including 'the Rule on Safety and Protection management for radioisotopes and radiation-emitting devices' are being prepared.

On basis of regulations no. 449, MEP (NNSA) has established categorisations for sealed and unsealed radioactive sources, as well as, radiation emitting devices, and uses these categorizations inter alia, in defining the thoroughness of authorisation processes and inspection frequencies. The categorization for sealed sources is based on the international categorization (IAEA RS-G-1.7). This categorization is the basis for a graded approach for the implementation of the regulatory requirements for safety.

The Regulations no 449 and SEPA order no. 31 ('Principles for licensing management of safety and protection for radioisotopes and radiation-emitting devices') address to some extent the security of radioactive source sources. However, these provisions cover elements of physical protection as well as requirements for detection of orphan sources in smelting industries[3].

The security provisions are equally applicable to all source categories they do not provide for a graded approach for security of sources. The IRRS Review Team was informed that NSC is currently preparing, on the request of the MEP (NNSA), a guide on the security of radioactive sources. The guide will introduce a graded approach for security as prescribed in the IAEA Security Series document No 11.

The IRRS Review Team was also informed that a new department rule is being prepared which tighten the obligation for radiation monitoring in smelting industries.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: GSR Part I, Req. 34 and para. 4.61 states that** *"Requirement 34: The regulatory body shall establish or adopt regulations and guides to specify the principles, requirements and associated criteria for safety upon which its regulatory judgements, decisions and actions are based."*

[3] From the implementation point of view, procedural arrangements are in place for ultimately notifying the provincial EPA of a discovered orphan source, including sources found at borders. The notification process may involve several agencies. Provincial EPA will then undertake the necessary response measures, investigate the origin and attempt to identify the owner. If identified, the owner will be made liable.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
R34	**Recommendation: MEP (NNSA) should finalize, approve and implement draft documents on 'Implementation Rule for Safety and Protection management of radioisotopes and radiation-emitting devices'**
(1)	**BASIS: GSR Part I "***4.61 The government or the regulatory body shall establish within the legal framework processes for establishing or adopting, promoting and amending regulations and guides. These processes shall involve consultation with interested parties in the development of the regulations and guides, with account taken of internationally agreed standards and the feedback of relevant experience. Moreover, technological advances, research and development work, relevant operational lessons learned, and institutional knowledge can be valuable and shall be used as appropriate in revising the regulations and guides.*
(1)	**BASIS: GSR Part 1 – Requirement 9: System for protective actions to reduce existing or unregulated radiation risks states that "***The government shall establish an effective system for protective actions to reduce undue radiation risks associated with unregulated sources (of natural and artificial origin) and contamination from past activities or events, consistent with the principles of justification and optimization.***"**
(2)	**BASIS: GSR Part 1 – Requirement 9: System for protective actions to reduce existing or unregulated radiation risks §2.25 states that** *"Radiation risks may arise in situations other than in facilities and activities that are in compliance with regulatory control. In such situations, if the radiation risks are relatively high, consideration shall be given to whether protective actions can reasonably be taken to reduce radiation exposures and to remediate adverse conditions [1]. Where unacceptable radiation risks arise as a consequence of an accident, a discontinued practice, or inadequate control over a radioactive source or a natural source, the government shall designate organizations to be responsible for making the necessary arrangements for the protection of workers, the public and the environment [6]. The organization taking the protective action shall have access to the resources necessary to fulfil its function"*
(3)	**BASIS: Code of Conduct on Sources, §8(c)** *"Every State should have in place an effective national legislative and regulatory system of control over the management and protection of radioactive sources. Such a system should: (c) include national strategies for gaining or regaining control over orphan sources."*
R35	**Recommendation**: **MEP (NNSA) should finalize and implement the draft Rule related to radiation monitoring at scrap metal and smelting industry**.
(1)	**BASIS: GSR Part I, Para 4.62 states that "***The regulations and guides shall provide the framework for the regulatory requirements and conditions to be incorporated into individual authorizations or applications for authorization. They shall also establish the criteria to be used for assessing compliance. The regulations and guides shall be kept consistent and comprehensive, and shall provide adequate coverage commensurate with the radiation risks associated with the facilities and activities, in accordance with a graded approach.*
GP9	**Good Practice: The graded approach is implemented in accordance with a risk-based categorization of radioactive sources and radiation-emitting devices. For sealed sources, China has adopted the IAEA categorization of sources and extended it to unsealed sources and radiation-emitting equipment.**

9.5. WASTE FACILITIES

Many of the "waste management" regulations in force in the China date from the late 80's and early 90's. For example, Format and Content for EIA's for Near Surface Disposal Facilities (SEPA, HJ/T 5.2, 1993) and Regulations on Shallow Land Disposal of Solid LILW (GB9132-88). Attachment 1 in the self-assessment report lists additional standards that are presently in force. There is no doubt that many of these need to be replaced by up-to-date standards. NSC will coordinate and organize the preparation of the regulatory documents. MEP (NNSA) has set up a committee to oversee the revision of standards – this committee has several subgroups, one of which deals with the body of waste standards.

Attachment 5 of MEP (NNSA)'s self-assessment report also lists the nuclear and radiation safety rules and guides to be produced and implemented in a five-year programme from 2010 to 2015. An appreciable number of these are "radioactive waste management" standards. In the self-assessment documentation from MEP (NNSA) the term "radioactive waste management" refers collectively to radioactive waste management, decommissioning, authorized discharges and remediation standards. The development of standards for radioactive waste management is going to be an area of intense activity for the next 5 years, for example:

- One of the two regulations to be promulgated is for the safety of radioactive waste management;
- Of the 16 departmental rules to be formulated, 3 are concerned with radioactive waste; and
- Of the 104 safety guides to be formulated, 19 are concerned with radioactive waste management.

At the level of regulations and departmental rules, the proposal for development of regulations and guides is reasonable. The development of guides would not seem to be as well prioritized or conceived. What is noticeable for the proposed guides is that they mix two "generations" of IAEA safety guides.

Article 27 of the Law on the Prevention and Control of Radioactive Pollution requires all operators of nuclear installations to draw up decommissioning plans. Nuclear power plants in operation or under construction have decommissioning plans. However, many existing nuclear installations (i.e., installations other than nuclear power plants) do not have such plans. Regulations concerning decommissioning plans should be established and cover the scope and content of the plans, and specify when they should be drawn up and revised. Proper decommissioning plans would provide an essential basis for facility specific cost estimates, including costs for the long-term management of the decommissioning waste arisings.

There is no regulatory standard defining the format and content of a safety case for predisposal radioactive waste management facilities (e.g. storage facilities). Presently, the format and content of safety assessment reports is developed on a case-by-case basis in consultation with the regulator.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS: WS-R-5 §3.5 states that** *"The regulatory body is responsible for the regulation of all phases of decommissioning, from initial planning to termination of the practice or final release of the facility from regulatory control. The regulatory body shall establish the safety standards and requirements for decommissioning, including management of the resulting radioactive waste, and shall carry out activities to ensure that the regulatory requirements are met."*
(2)	**BASIS: WS-R-5 §3.6 states that** *"The responsibilities of the regulatory body include:* *—Establishing criteria for determining when a facility or part of a facility is permanently shut down, based on termination of the authorized activities[4];* *—Establishing safety and environmental criteria for the decommissioning of facilities, including criteria for clearance of material during decommissioning and conditions on the end state of decommissioning and on the removal of controls;*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	—Establishing requirements for decommissioning planning; *—Reviewing the initial decommissioning plan and reviewing and approving* *the final decommissioning plan before allowing decommissioning activities to be commenced;* *—Implementing inspection and review of decommissioning activities and* *taking enforcement actions in case of non-compliance with safety requirements;* *—Establishing policies and requirements for the collection and retention of records and reports relevant to decommissioning;* *—Evaluating the end state of a decommissioned facility and deciding whether the conditions have been met to allow the termination of the practice and/or release from regulatory controls or whether further activities or controls are needed;* *—Giving interested parties an opportunity to provide comments on the plan before it is approved."*
(3)	**BASIS: WS-R-5 §5.7 states that** *"This initial plan shall be reviewed and updated periodically, at least every five years or as prescribed by the regulatory body, or when specific circumstances warrant, such as if changes in an operational process lead to significant changes to the plan. Revisions or amendments shall also be made as necessary in the light of operational experience gained, new or revised safety requirements or technological developments. If an incident or accident occurs, the decommissioning plan shall be reviewed as soon as possible and modified as necessary."*
(4)	**BASIS: WS-R-5 §6.3 states that** *"The amount of financial assurance obtained shall be consistent with a facility specific cost estimate and shall be changed if the cost estimate increases or decreases. The cost estimate shall be reviewed as part of the periodic review of the decommissioning plan."*
(5)	**BASIS: GSR Part 5 Requirement 20: Shutdown and decommissioning of facilities states that** *"The operator shall develop, in the design stage, an initial plan for the shutdown and decommissioning of the predisposal radioactive waste management facility and shall periodically update it throughout the operational period. The decommissioning of the facility shall be carried out on the basis of the final decommissioning plan, as approved by the regulatory body. In addition, assurance shall be provided that sufficient funds will be available to carry out shutdown and decommissioning [4]."*
R36	**Recommendation: MEP (NNSA) should develop regulations for decommissioning plans covering:** • **When decommissioning plans should be drawn up;** • **Scope and content of the plan; and** • **Periodic revision of the plan.** **The regulations should cover decommissioning plans for existing as well as for planned nuclear installations.**
(1)	**BASIS: GSR Part 5 Requirement 3: Responsibilities of the regulatory body states that** *"The regulatory body shall establish the requirements for the development of radioactive waste management facilities and activities and shall set out procedures for meeting the requirements for the various stages of the licensing process. The regulatory body shall review and assess the*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	safety case[3] *and the environmental impact assessment for radioactive waste management facilities and activities, as prepared by the operator both prior to authorization and periodically during operation. The regulatory body shall provide for the issuing, amending, suspension or revoking of licences, subject to any necessary conditions. The regulatory body shall carry out activities to verify that the operator meets these conditions. Enforcement actions shall be taken as necessary by the regulatory body in the event of deviations from, or non-compliance with, requirements and conditions. (See Ref. [5].)"*
(2)	**BASIS: SSR-5 (DS354) – Requirement 2: Responsibilities of the regulatory body states that** *"The regulatory body shall establish regulatory requirements for the development of different types of disposal facility for radioactive waste and shall set out the procedures for meeting the requirements for the various stages of the licensing process. It shall also set conditions for the development, operation and closure of each individual disposal facility and shall carry out such activities as are necessary to ensure that the conditions are met.*
R37	**Recommendation: For the Legislative plan for the period 2010-2015,** MEP (NNSA) **should assign suitable priority to the development of the regulations and rules for radioactive waste management. The proposed suite of guides for radioactive waste management to be produced in the same period should be re-evaluated in light of the current plans for the development of the IAEA safety standards.**

10. EMERGENCY PREPAREDNESS AND RESPONSE

10.1. LEGAL BASIS

The legal basis for emergency preparedness and response for China was based on the Law on Prevention and Control of Radioactive Pollution (2003), the Regulation on the Safety of Civilian Nuclear Installations, ref. HAF 001 (earlier ref. as HAF-500, 2007), which also covers research reactors, fuel fabrication and reprocessing facilities, the Emergency Management Regulation for a Nuclear Accident at a Nuclear Power Plant, ref. HAF 002 (earlier ref. as HAF-700, 1993), Regulation on Safety and Protection of Radioisotopes and Radiation-Emitting Devices (2005), Rule of Trans-boundary Radiation Emergency Management (2002). MEP (NNSA) is responsible for regulatory emergency preparedness at nuclear licensed sites and for radioactive sources that can cause so called significant or exceptionally serious radiological accident (which partially answer Category I radioactive sources) in China.

During a nuclear emergency or a radiological emergency that can cause significant or exceptionally serious radiological accident, the MEP (NNSA) is expected to operate their emergency centre in Beijing and provide independent expert advice to national and local authorities for protection of the public. During a radiological emergency caused by radioactive sources of Categories other than Category I provincial authorities are expected to operate their emergency centres and provide relevant services.

This has resulted in:

a) a three level nuclear emergency preparedness and response system being established in China. The system is structured including:

1. a National Coordinating Committee on Nuclear Emergency (NNCCE) set by the State Council; ¨
2. a similar-functioned committee in nuclear infrastructure-existing provinces/autonomous region/municipality) set by people's governments in regions; and
3. a nuclear emergency mechanism in operating organizations of nuclear installations, respectively managing nuclear emergency preparedness and response activities within China, regions or organizations.

Each of three levels will prepare emergency plan of responding to nuclear emergencies; these plans have relevant interfaces.

b) a three level radiological emergency system:

1. an emergency organization set by MEP (NNSA) ;
2. a similar-functioned organization in Environmental Protection Dept. of provinces/autonomous region/municipality set by people's governments in regions; and
3. a radiological emergency mechanism in operating organizations of radioactive sources.

Each of the three levels will prepare an emergency plan detailing their response to radiological emergencies; these plans have relevant interfaces.

MEP (NNSA) is responsible for reviewing and approving of an on-site nuclear emergency plan formulated by organizations operating nuclear facilities, resp. those operating within the nuclear fuel cycle, of MEP (NNSA) Nuclear Emergency Plan, of MEP (NNSA) Radiation Emergency Plan and of radioactive sources Cat. I operators emergency plan.

MEP (NNSA) do not have a regulatory role in approving the national emergency plans or provincial emergency plans where nuclear licensed sites are located. However, the NNSA staff did confirm they

were asked by those responsible for approving emergency plans at national and regional level to provide advice on plans for nuclear power plants.

10.2. ASSESMENT OF THREATS

The IRRS Review Team was informed that a radiological threat assessment using threat categories as introduced in IAEA GS-R-2 "Preparedness and Response for Nuclear or Radiological Emergency" has not yet been performed at national level. But it can be said that indirectly the categorization is applied to facilities of Cat. I and II.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS**: **GS-R-2 § 3.6 states that** "*For the purposes of the requirements nuclear and radiation related threats are grouped according to the threat categories shown in Table I. The five threat categories in Table I establish the basis for developing generically optimized arrangements for preparedness and response. Threat categories I, II and III represent decreasing levels of threat at facilities and in the corresponding stringency of requirements for preparedness and response arrangements. Threat category IV applies to activities that can lead to emergencies occurring virtually anywhere; it is also the minimum level of threat, which is assumed to apply for all States and jurisdictions. Threat category IV always applies to all jurisdictions, possibly together with threats in other categories. Threat category V applies to the off-site areas where arrangements for preparedness and response are warranted to deal with contamination resulting from a release of radioactive material from a facility in threat category I or II.*"
(2)	**BASIS**: **GS-R-2 § 3.15 states that** "*The nature and extent of emergency arrangements [for preparedness and response] shall be commensurate with the potential magnitude and nature of the [threat]… associated with the facility or activity." (Ref. [10 = GS-R-1], para. 6.4.) The full range of postulated events shall be considered in the threat assessment. In the threat assessment, emergencies involving a combination of a nuclear or radiological emergency and a conventional emergency such as an earthquake shall be considered. Any threat associated with nuclear facilities in other States shall also be considered. In the threat assessment any populations at risk shall be identified and, to the extent practicable, the likelihood, nature and magnitude of the various radiation related threats shall be considered. The threat assessment shall be so conducted as to provide a basis for establishing detailed requirements for arrangements for preparedness and response by categorizing facilities and practices consistent with the five threat categories shown in Table I.*"
(3)	**BASIS**: **GS-R-2 § 3.16 states that** "*Operators, the national coordinating authority and other appropriate organizations shall periodically conduct a review in order to ensure that all practices or situations that could necessitate an emergency intervention are identified, and shall ensure that an assessment of the threat is conducted for such practices or situations. This review shall be undertaken periodically to take into account any changes to the threats within the State and beyond its borders, and the experience and lessons from research, operating experience and emergency exercises.*"
R38	**Recommendation: MEP (NNSA), MII/CAEA and NEA should promote the elaboration and approval of a legal and regulatory framework for an assessment of the threats by categorizing facilities and practices in accordance with the IAEA safety standards.**

10.3. RESPONSIBILITY OF THE MEP (NNSA) EMERGENCY ORGANIZATION

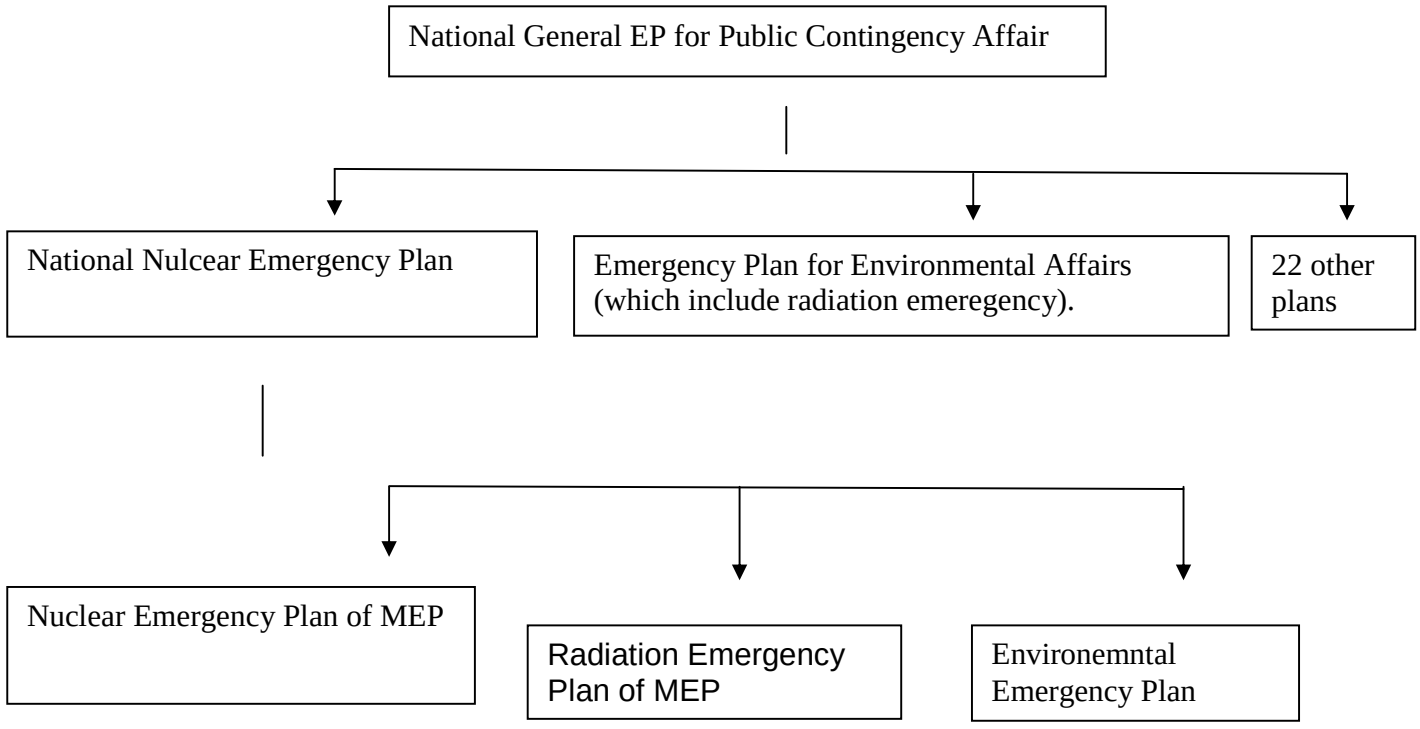
China has a wide and complex national emergency preparedness organization. MEP（NNSA） reported that there exist following emergency plans (from which some of them are prepared and/or reviewed and/or approved by MEP（NNSA):

National General Emergency Plan for Public Contingency Affair; under this plan there are 24 type plans, among others:

- National Nuclear Emergency Response Plan for Nuclear Accidents; and
- National Contingency Emergency Plan for Environmental Affairs (which includes also radiological emergencies).

All the above mentioned plan were issued by the State Council.

MEP (NNSA) then prepared and issued Contingency Plan for Nuclear Accidents and Radiation Emergency Plan. With respect to this plan following plans were prepared and issued. (see Fig. 10.3-1)



-------- some relation exists

Fig. 10.3-1

MEP（NNSA） staff confirmed they have following emergency documentation:

- National Nuclear Emergency Plan (issued in 2006);

- National Contingency Emergency Plan for Environmental Affairs (which includes also radiological emergencies) (Issued in 2006);
- Nuclear Emergency Plan of MEP (NNSA） (issued in 2009);
- Radiation Emergency Plan of MEP (NNSA） (issued in 2009); and
- State Environmental Protection Administration Nuclear Accident Emergency Implementation Procedures (issued in November 2007).

National Nuclear Emergency Plan covers: technical basis; emergency organizations; emergency preparedness; emergency response; emergency termination and procedures of recovery normal.

MEP Nuclear and Radiation Emergency Plans cover: MEP (NNSA) nuclear and radiation emergency organization and its responsibilities; emergency phases, classification of radiation accident; emergency action; adjustment, closure, termination of emergency, and recover of emergency measures; emergency material safeguard.

Implementation procedures cover 7 various procedures.

The system of nuclear emergency organization can be seen from Fig. 10.3 –2.

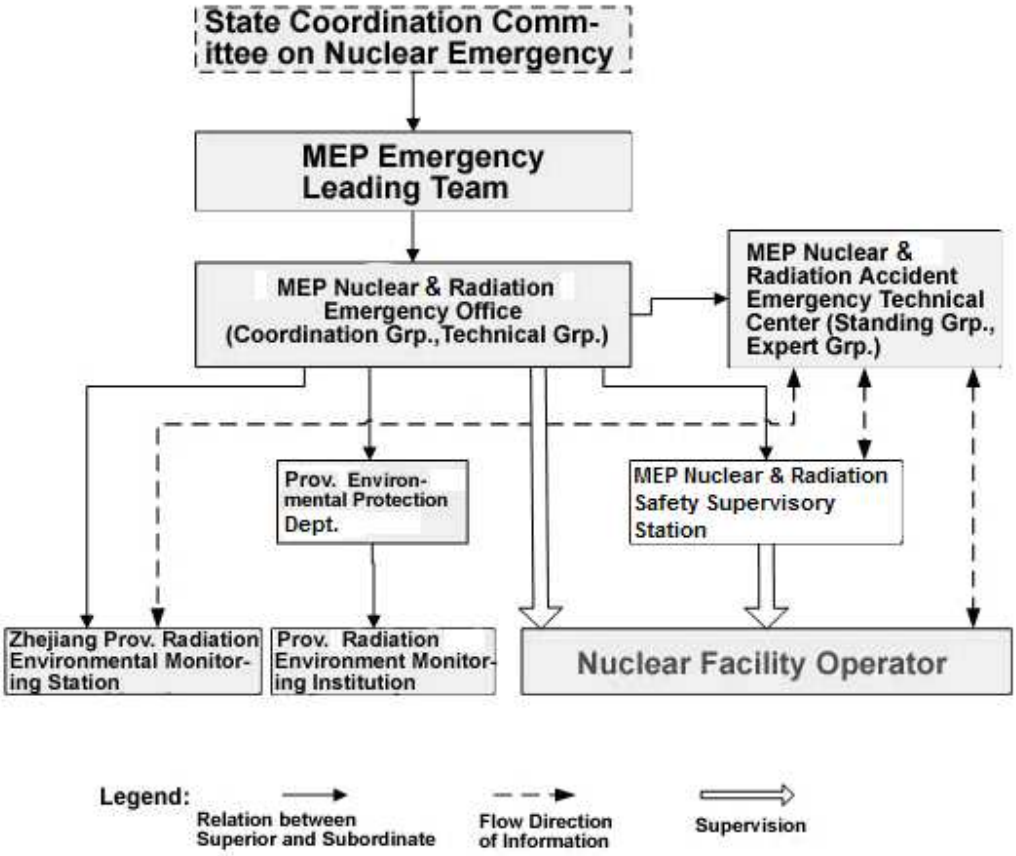


Fig. 10.3 –2.

With regard to the nuclear accidents preparedness and response MEP (NNSA) is responsible for:

a) reviewing and approving of an on-site nuclear emergency plan formulated by organizations operating nuclear facilities;

b) reviewing and approving MEP (NNSA) Nuclear Emergency Plan;

c) guiding and coordinating the preparedness of all sectors in the MEP (NNSA) emergency organizational system;

d) organizing to prepare the MEP (NNSA) Nuclear Emergency Plan and executive procedures on nuclear accidents;

e) daily preparedness of intra-system emergencies within the MEP (NNSA) and regulatory management on emergency-related preparedness within environmental protection system throughout China;

f) the liaison and information exchange among the State Coordination Committee on Nuclear Emergency and any relevant ministries, departments and sectors; and

g) daily supervision over operation organizations emergency preparations.

The system of radiological emergency organization can be seen from Fig. 10.3 –3.

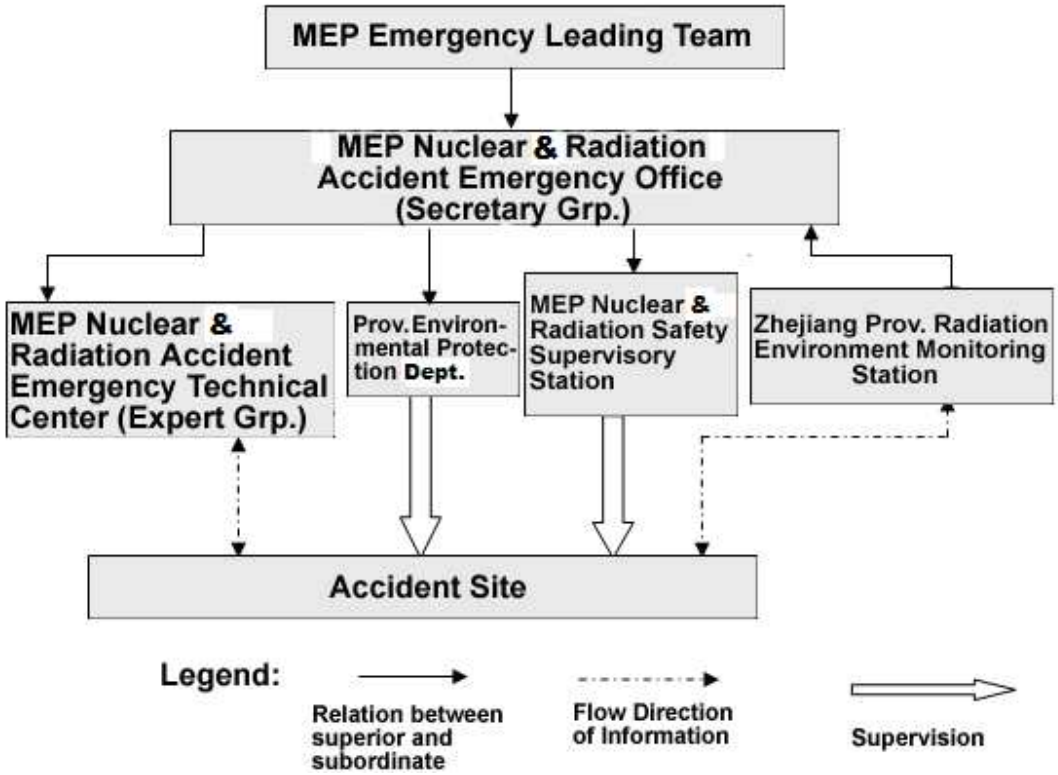


Fig. 10.3 –3. MEP (NNSA) Radiation Emergency Organizational System

With regard to the radiological accidents preparedness the MEP (NNSA) is responsible for:

a) review and approval of the MEP (NNSA) Radiation Emergency Plan and executive procedures;

b) leading and coordination the preparedness of departments and sectors within the MEP (NNSA) emergency system;

c) instruction or commanding of provincial environmental protection authorities;

d) fulfilling the daily tasks of emergency preparedness within the MEP (NNSA) system;

e) settlement of radiation-related reports submitted by local environmental protection authorities, and follow radiation emergency related instructions or orders issued by the central government, the State Council or MEP (NNSA);

f) issuing of orders of temporary control or inspection over radioactive sources facilities or devices, according to the State Council requirements or the nature of environmental emergencies; and

g) keeping liaison and information exchange with ministries, departments or other authorities.

The duty officer of the MEP (NNSA) ensure an acceptance of a message about a nuclear accident occurrence while the duty officer of the Nuclear and Radiation Accident Emergency Response Centre ensure an acceptance of a message about a nuclear accident occurrence. The duty service of both is in regime 24 hours/7 days/week, the duty officers are backed-up and at least 2 shifts exists. The first announcement is telephonic followed by the fax message. For fax messages are prepared relevant fax forms.

MEP (NNSA) has adopted a system of prepared notification fax form to ensure the content of the notification on all levels of the national emergency preparedness system is comparable.

The MEP (NNSA) does not perform the function of the National Point of Contact with regard to the IAEA's Convention on Early Notification of a Nuclear Accident and the IAEA's Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; this is performed by the CAEA.

During a nuclear emergency MEP (NNSA) – by way of the so called Environmental Emergency Leading Team (ELT) - provides advice to the National Coordination Committee on Nuclear Emergency (NCCNE) through its parent organization – Ministry of Environmental Protection (MEP) (this reporting route is also used at the local government level of emergency response). So the MEP (NNSA) is represented at NCCNE (National Coordination Committee on Nuclear Emergency) by Vice Minister, i.e. the Head of NNSA; if he is not available then NNSA can be represented by the Chief Engineer for Nuclear Safety or by the Director of the Nuclear Safety Dept. ELT of which the secretary and executive agency is the Nuclear and Radiation Accident Emergency Office major responsibilities are:

a) decision on the launch and closure of MEP (NNSA) response to nuclear accidents;

b) coordination of the responses of all sectors in MEP (NNSA) emergency organizational system;

c) instructing of provincial environmental protection authorities on monitoring radiation environment during emergencies;

d) approval of operating organizations interventions in response to emergencies;

e) approval of an Accident Report and an Emergency Response Report before their submitting to the State Council and to the State Coordination Committee of Nuclear Emergency;

f) assistance to reviewing and disclosure of information and news about nuclear accidents; and

g) organizing to assess and supervise operating organizations responses to nuclear emergencies; and if necessary, taking intervening action upon approval of ELT.

The working place of ELT is the MEP (NNSA) Nuclear and Radiation Accident Emergency Technical Center. The Nuclear and Radiation Accident Emergency Technical Center has gradually built its competence in responding to emergencies, has built the real-time transmission of reactor operation parameters and monitored radiation and meteorological data between the operating nuclear power plant and the ERC. The Center is among others equipped by computer modelling tools (such as RIMPUFF) that permit various impact scenarios to be run using a user configurable source term, and the ability to assess the potential consequences of an overseas nuclear event that may impact China was noted. There are communications facilities for convening meetings and liaising with other parties via teleconference and multiple redundancies for essential communications. So the Center nowadays represents a robust coordinating and decision supportive place.

Other parts of the MEP (NNSA) emergency response organizations are properly equipped according to their duties and responsibilities, including communication devices, vehicles, radiation monitoring equipment, radiation software, personal protective equipment and documentation. If necessary the expertise to first responders is primarily given by NPP. If necessary or requested, MEP (NNSA) can give advice or send the mobile group to local authorities. Local authorities who ensure the first response decide where to send this mobile group. Mobile radiation monitoring capability of MEP (NNSA) is following:

3 groups – analysis laboratory (e.g. γ and α spectrometers, low background α and β counter, airborne and environmental samples pre-treatment);

4 groups – mobile radioactivity monitoring (e.g. α, β, γ, neutron and aerosol real-time detectors/monitors, γ on-site spectrometry, sampling devices); and

6 groups – emergency radiation monitoring vehicles (e.g. γ dose rate continuous monitor, airborne monitor, portable devices for sampling, surface contamination monitoring).

MEP (NNSA) operates emergency response vehicles which are properly equipped and which if necessary can be sent assist response teams, namely to the off-site teams.

All MEP (NNSA) staff that are certified inspectors has a role in responding to a nuclear emergency which requires the mobilization of its resource. This covers inspectors being sent to site if they are not already there and operation of the MEP (NNSA) emergency centre in Beijing. In addition, MEP (NNSA) would be supported by technical experts in their Nuclear Safety Centre in Beijing.

MEP (NNSA) emergency response organizations at each level make due preparations daily and develop and practice plans for staff training and exercise.

For the purposes of an emergency – based on the Regulations on the Management of Dedicated Emergency Funds for Nuclear Incidents in Nuclear Power Plants (2007, Ministry of Finance and China Atomic Energy Authority) – it was established emergency fund: the MEP (NNSA) emergency response organizations at each level propose and submit financial budget to fiscal authorities for approval, which provides that adequate financial resources to daily preparedness and emergency response are available.

Radiological emergency response is organized on the basis of regional authorization with an exception that MEP (NNSA) organizes response to significant radiation accident. Provincial environmental protection authorities ensure the response to major, comparatively major and ordinary emergencies. Each MEP (NNSA) radiation emergency organization shall duly act or respond to accidents.

For the purpose of timely and effectively responding radiation accidents arising from production, sale and application of radioactive isotope or radioactive equipments, and controlling or mitigating the impacts thereof, MEP (NNSA) along with Ministries of Public Security and Health jointly issued the Announcement for Establishing a System of Radiation Accident Occurred in Radioactive Isotope and Radioactive Installation Be Handled in Category as well as a Reporting System (hereinafter as the Announcement) based on the classification and settlement of radiation accidents referenced in the Regulations on Safety and Protection against Radioactive Isotope and Devices Emitting Radioactive Rays (the State Council Order No. 449, revised in 2005).

As Announcement requires in case of radiation emergencies, the accident-stricken organization shall immediately launch their radiation emergency plan, take necessary protection measures, and complete and report the Initial Report on Radiation Accident within 2 hours to local authorities of environmental protection and public security. Additionally, the organization shall report to local health administrations if anyone is or would be probably exposed to extra radiation dose.

Upon receiving the notification, authorities of environmental protection, public security and health shall report the information within 2 hours to their higher authorities respectively up to those at province level.

In case of significant radiation accidents, the authorities may report to the MEP (NNSA), the Ministry of Public Security and the Ministry of Health at the same time.

Upon acknowledgement of various radiation accidents, authorities of environmental protection, public security departments and health at provincial, city and county levels shall, according to requirements of emergency plan and significance of accidents, immediately send staffs for in-situ survey, heed effective measures to control and mitigate the impact and report it to the government at the same level. Upon the settlement of accidents, the provincial environmental protection authority shall submit a follow-up report on the accident to the MEP (NNSA).

If a provincial environmental protection authority receives a report and considers it as a significant or major accident, it shall timely notify provincial authorities of public security and health, and report within 2 hours to the MEP (NNSA). Upon receiving the report and confirming the accident grading quickly, the MEP (NNSA) shall report it within 2 hours to the State Council and notify the Ministry of Public Security and the Ministry of Health.

When a radiation accident occurs the MEP (NNSA) Emergency Leading Team (ELT) shall:

a) make decisions of launching, adjusting or terminating the MEP (NNSA)'s status of radiation emergencies;

b) lead and coordinate the responses of departments and sectors within the MEP emergency system;

c) give instruction or command provincial environmental protection authorities;

d) organize to regulate and assess the responses to radiation emergencies and measures taken by organizations in question (MEP (NNSA)'s regulated objects);

e) instruct and coordinate responses to major radiation accidents;

f) review and approve the report to be submitted to the State Council on major or significant radiation accidents; and

g) disclose the information about radiation accidents.

The MEP (NNSA) Nuclear and Radiation Emergency Office shall:

a) direct and comprehensively coordinate the launch and cooperation of radiation emergency organizations within MEP (NNSA) system;

b) initiate and submit an accident report to the State Council in case of major or serious accidents;

c) organize to regulate, trace and assess the responses and measures taken by organizations in question (MEP (NNSA)'s regulated objective) to radiation emergencies; and as necessary, take an intervening action upon approval of MEP (NNSA) Emergency Leading Team; and

d) draft the news or information concerning radiation accidents.

In order to sustain the competence in responding emergencies, the MEP (NNSA) emergency response organizations at each level make due preparations daily and develop and practice plans for staff training and exercise, however there exist various training programmes both at national and all local/provincial level and thus it should be very convenient to improve these programmes in order to ensure consistent training package and education for local/provincial government.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS**: **GS-R-2 § 5.31 states that** "*The operator and the response organizations shall identify the knowledge, skills and abilities necessary to be able to perform the functions specified in Section 4. The operator and the response organizations shall make arrangements for the*

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
	selection of personnel and for training to ensure that the personnel have the requisite knowledge, skills, abilities, equipment, and procedures and other arrangements to perform their assigned response functions. The arrangements shall include ongoing refresher training on an appropriate schedule and arrangements for ensuring that personnel assigned to positions with responsibilities for emergency response undergo the specified training."
S41	**Suggestion: MEP (NNSA) should consider an improvement of existing training emergency preparedness programmes and education, namely for local/provincial environmental authorities (as first response organizations at the local/provincial level) to ensure that the personnel both at headquarters and at provinces have the comparable knowledge and skills.**

As confirmed by the MEP (NNSA) staff the MEP emergency plans are exercised which is based on the procedure 5 is as written, i. e. on "State Environmental Protection Administration Nuclear Accident Emergency Drills Implementation Procedure". The MEP (NNSA) last year prepared exercise for the emergency group as a player; other times the NNSA representatives perform as an observer. The IRRS Review Team was advised that during exercises simulated on-line environmental monitoring and NPP technological faxed data is used.

MEP (NNSA) does not apply any QA system at the Nuclear and Radiation Accident Emergency Technical Centre. It is under consideration as a part of the improvements observed and discussed with the Deputy Director of Nuclear and Radiation Accident Emergency Technical Centre to introduce QA system.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS : GS-R-2 § 5.47 states that** *"The operator of a facility, practice or source in threat category I, II, III or IV and the off-site response organizations shall establish a quality assurance programme, in accordance with international standards, to ensure a high degree of availability and reliability of all the supplies, equipment, communication systems and facilities necessary to perform the functions specified in Section 4 in an emergency. This programme shall include arrangements for inventories, re-supply, tests and calibrations, made to ensure that these items and facilities are continuously available and functional for use in an emergency. Arrangements shall be made to maintain, review and update emergency plans, procedures and other arrangements and to incorporate lessons learned from research, operating experience (such as the response to emergencies) and emergency drills and exercises."*
R39	**Recommendation: MEP (NNSA) should establish a quality assurance programme to ensure a high degree of availability and reliability of all the supplies, equipment, communication systems and facilities necessary to perform the assigned response functions, namely at the Nuclear and Radiation Accident Emergency Technical Centre.**

During the discussions with IRRS, the MEP (NNSA) confirmed the following:

a. emergency plans on various state administration levels exist, are verified by exercises and drills and reviewed if necessary;

b. Nuclear and Radiation Accident Emergency Technical Centre number of staff is relevant to operating NPPs and radioactive sources Cat. I and supposed to be increased with respect to

planned number of new reactors; this staff is trained and skilled and if necessary can ask advice from other expert bodies (e. g. universities, research institutes);

c. Nuclear and Radiation Accident Emergency Technical Centre is well equipped with the communication devices, with soft ware tools for estimation and prediction of situation connected with an emergency situation at any NPP; moreover the Centre disposes with two emergency vehicles determined for emergency communication and radiation monitoring; and

d. MEP (NNSA) is well prepared to provide advice to national and local government in an nuclear or radiological emergency.

From the information sampled and discussions held with MEP (NNSA) staff on the emergency preparedness arrangements the following conclusions were made: MEP (NNSA) has prepared emergency plans to respond to nuclear and very significant radiological emergencies; detailed procedures have been provided to support the plan; duty officers for permanent acceptance of an notification about an emergency occurrence were established; emergency exercises were routinely carried out by participation in licensees emergency scenarios; emergency plans for major, serious and ordinary radiological were prepared by the relevant local/provincial Environmental Protection Authorities; no training programme for staff of these local/provincial Environmental Protection Authorities was neither developed nor implemented so the level of staff knowledge and preparedness to radiological accidents can be various; Nuclear and Radiation Accident Emergency Technical Centre documentation and equipment is prepared, purchased or operated without an appropriate quality system being implemented at the Centre.

10.4. RESPONSIBILITIES OF THE MOH EMERGENCY ORGANIZATION

The main responsibilities of Ministry of Health in the field of emergency preparedness to nuclear and radiological accidents are:

i. clinical treatment in response to nuclear and radiation emergencies; and preparedness of medical proposals and policies;

ii. nuclear and radiation-related public health emergencies monitoring, pre-warning and risk-assessing; safety guides on prevention and control, and disclosure of information of emergency response; and

iii. medical aid to organizations where nuclear and radiation accident occurs.

The IRRS Review Team was among others informed that

e. in 1984, a coordination group for health protection for NPP workers was established;

f. in 1997, a management centre for medical response to nuclear and radiological emergencies was established;

g. in 2002, the “Medical Emergency Plan of Ministry of Health for Nuclear and Radiation Accident” was approved, the Plan was revised in 2009. This plan was prepared as a 3-level plan (national, departmental and provincial levels) and it is verified in a 2 years period in the form of a national exercise and a-lot of routine, partial exercises are organized in the meantime; and

h. in 2004, the Chinese Centre for Medical Response to Radiation Emergencies became a member of the relevant system of WHO and in 2005 and 2008 took part in drills organized by the WHO.

10.5. RESPONSIBILITIES OF THE CHINESE ATOMIC ENERGY AUTHORITY

The CAEA performs, as its department, an administrative organization for national nuclear emergency - the National Nuclear Emergency Response Office (NNERO) – see Fig. 10. 5-1. Its main responsibilities are as follows:

- Carrying out nuclear emergency policies of the State Council and the NCCNE;
- Taking charge of routine activities of the NCCNE;
- Implementing the national nuclear emergency plan, inquiring, coordinating and supervising emergency preparedness activities of member organizations of the NCCNE, notifying, guiding, and coordinating related emergency preparedness of local governments and NPPs;
- Taking charge of receiving, handling, transmitting, notifying, and reporting information on nuclear and radiation emergency as the Point of Contact; undertaking the affairs for implementing relevant international convention and bilateral or multilateral cooperation agreements, and requesting international aids as a national emergency liaison point to the external;
- Preparing national nuclear emergency work programming and annual work plan; Working out scientific research plan and scheme of technical support system for emergency;
- Organizing the reviews of the off-site emergency plan, the off-site integrated exercise plan, and the joint exercise plan of on-site and off-site; making the review comments;
- Organizing activities of liaison persons and experts advisory group.;
- Organizing relevant training and exercise on nuclear emergency;
- Collecting information, putting forward report and proposal, timely communicating and executing decisions and orders from the State Council and the NCCNE, checking and reporting the evolution of implementation when responding to emergency; and
- Undertaking related affairs decided by the NCCNE after termination of emergency situation.

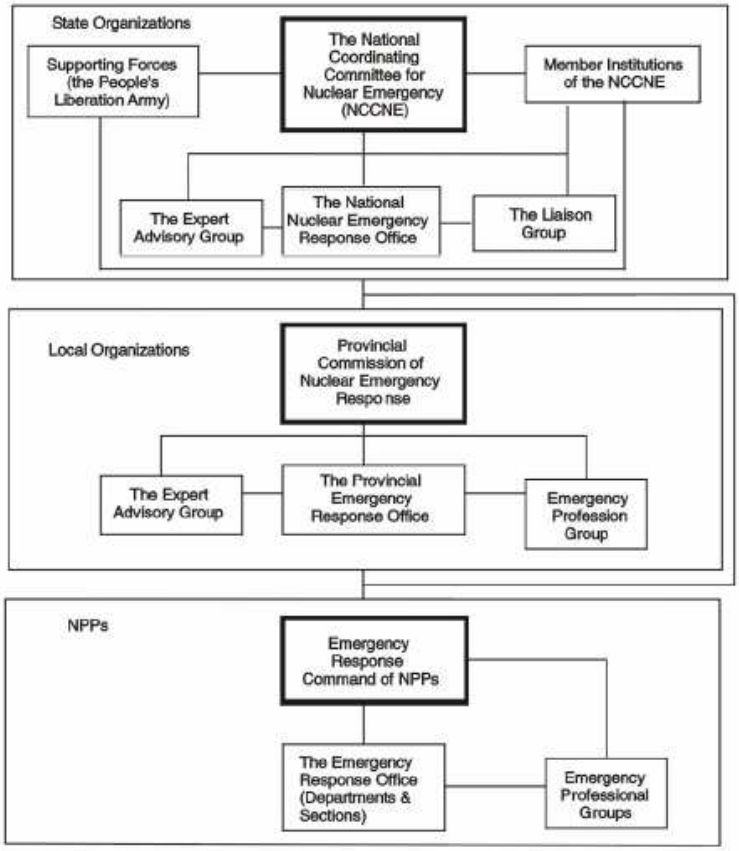


Fig. 10.5-1Organizational Structure of National Nuclear Emergency response System

The CAEA is responsible for approval of off-site emergency plans prepared by the local/provincial authorities. When preparing its off-site programme each province is obliged to follow safety guide. The CAEA intention is to prepare a regulation for the off-site plans preparation.

The off-site plans are verified by each province namely by means of emergency exercises; these provinces where NPPs are operated are more skilled. Up to now the CAEA organized only 1 national emergency exercise in 2009. The simulated emergency situation was situated in a province and all other have to cooperate and cope with this emergency situation. The CAEA made among others an experience that seeking for a volunteer "accident" province takes a long time.

The CAEA performs as the Point of Contact in terms of the IAEA's Convention on Early Notification of a Nuclear Accident and the IAEA's Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency; it means that the CAEA is responsible for communication in the frame of ENATOM system and that in case of an abroad accident impact to the territory of China it would be the CAEA responsibility to prepare a proposal of a response. However for such a situation were not yet been prepared any rules or instructions.

There are currently only 3 provinces where NPPs are operated; however, in the near future, NPPs will be operated in another 4 provinces. In April 2010, CAEA organized a workshop for these "new" provinces emergency staff to present the nuclear accident management rules and provide an introduction of the communication and informing channels both among these provinces and to the CAEA.

10.6. REGULATION OF LICENSEES EMERGENCY PREPAREDNESS

MEP (NNSA) regulates nuclear site licensee's emergency arrangements by approval of their emergency plan. MEP (NNSA) receives the emergency exercise plans of each operator licensed by them by the end of each year which means that NNSA can prepare a review of all exercises planned for the next year. Then the date of emergency exercise performance is announced to MEP (NNSA); as soon as the date is known the inspections can be planned/performed. Emergency plans are regularly reviewed (at least in a 2 year period), after re-approval of the plan an emergency exercise is performed; this exercise is a subject of an inspection.

The MEP (NNSA) ensures that the arrangements for preparedness and response as settled by the operator of nuclear facility emergency plan are in place by inspecting or observing emergency exercises which are conducted by the operators at least each two years as a follow-up of their emergency plan re-approval.

Emergency preparedness requirements for nuclear site licensees is covered by documents provided by the MEP (NNSA) in HAF-02/01, HAD-002/01 for power reactors, HAD002/06 for research reactors and HAD 002/07 for civil nuclear fuel cycle facilities.

The Ministry of Health regulates emergency preparedness of radioactive sources and area is covered by documents: Guideline on Public Dose Monitoring and Evaluation during Normal Operation and Incidents, Guideline on Medical Services for Nuclear Incident Emergency Management, Intervention Levels and Derived Intervention Levels of Public Protection in Times of Nuclear Incidents or Radiation Emergencies. Details are described in safety guides.

NPPs, research reactors and nuclear fuel cycle facilities operating organizations develop an emergency on-site plan with content including emergency response organizations, duties, detailed schemes for preparedness and response, infrastructures/facilities, support and technical issues. Adhering to principles of being "positive and compatible", operating organizations shall set up and maintain necessary technical support or back-up centres relating to emergency response supportive system, radiation monitoring, medical treatment, weather service and technical support to nuclear power plant emergency operation, in order to ensure organizations' competence of responding emergencies. The emergency plan formulated by operating organizations shall be reviewed and approved by the MEP (NNSA).

China's nuclear facilities emergencies are designated into four classifications:

i. Emergency Standby: the occurrences of specific working conditions or external events may put the safety of nuclear power plant into risks, thus calling for relevant staffs' awareness and informing off-site emergency organizations as necessary;

ii. Plant Emergency: radiation risk is limited within part of nuclear power plant, thereby mobilizing in-plant staff and informing off-plant emergency organizations;

iii. Site emergency: radiation risk is only limited within plan site, consequently mobilizing staffs in plant, informing off-plant emergency organizations, and mobilizing some organizations as necessary; and

iv. General Emergency (Off-site emergency): radiation risk exceeds site boundaries, thus mobilizing on-site and off-site staffs and practicing on-site and off-site emergency plan.

In case that emergency awareness/standby is declared nuclear emergency office of the plant shall promptly report the situation to higher authorities, i. e. to the MEP (NNSA) and if necessary to the relevant provincial nuclear accident emergency committee. If radioactive material is apt to release or has released, the operating unit must promptly decide to declare plant, in a site emergency and immediately report to higher authority, the MEP (NNSA) or provincial nuclear emergency committee. In case radioactive substances are likely to spread out or have already spread out the plant, the organization shall immediately inform the provincial nuclear accident committee and propose protection measures, whilst the committee, upon notification, shall promptly response to emergencies and report to the MEP (NNSA) Nuclear and Radiation Emergency Office.

Before fuel loading all the emergency-related staff (including commander) at NPP shall receive systematic training, take part at drills and exercises and pass exams. Following professional trainings and exams within plant lifecycle has been performed on an annual period. Similar procedures are applied to emergency staff at other nuclear facilities.

The IRRS visited the Peking University Hospital Medical Centre (PUHMC). PUHMC advised they have plans in place to deal with receiving a radiation accident casualty delivered to their Accident and Emergency Department. Similar arrangements exist at designated hospitals throughout major population centres, a direct result of preparations for the recent Olympics in 2008. The IRRS Review Team was advised that these arrangements are integrated into the hospitals mass casualty plans but the IRRS Review Team was unable to explore these aspects further due to limited time. The expected elements of identified treatment areas and standard internal operating procedures are expected to exist, but remain unconfirmed. It is unknown if mass decontamination facilities are available either at the hospitals for persons transported to hospitals or "walking wounded", or what the overall arrangements are for persons requiring acute medical care with radioactive contamination as a confounder. The IRRS Review Team was advised that the PUHMC had limited capacity to deal with acute high dose radiation casualties.

During discussions with the MEP (NNSA) staff the following conclusions were reached:

- an emergency plan approved by the MEP (NNSA) exists for each of the nuclear sites; at least each 2 years these plans are re-approved;
- routine drills and exercises were carried out by the licensee;
- the MEP (NNSA) inspects emergency exercises which are carried out every 2 years (after plan re-approval); and
- the licensee takes the lead in designing emergency exercise scenarios.

10.7. SYSTEM FOR PROTECTIVE ACTIONS TO REDUCE EXISTING OR UNREGULATED RADIATION RISKS

The response to a nuclear emergency at the local level is led by the provincial government of the area in which the nuclear licensed site is located. To manage the off-site response the provincial governments implement emergency coordinating committee which are responsible for the first response and for implementing protective measures, including stable iodine distribution. If necessary (requested), MEP (NNSA) (Nuclear and Radiation Accident Emergency Technical Centre) can send experts to the site or to the local authorities to assist them, namely in radiation monitoring. The Committee are also responsible for long-term countermeasures implementation when necessary.

As required by laws and regulations, persons responsible for radiation protection in radiation-involved organizations which are claimed

a) engagement in producing, selling and using radioactive sources, or;

b) ownership of work site of non-sealed radioactive sources, or ;

c) applications of radioactive installation or mobile gamma rays detection apparatus.

shall receive trainings from MEP (NNSA) recommended training organizations. Other radiation workers shall receive trainings from training organizations recommended by competent environmental protection authorities under provincial governments. By now, MEP (NNSA) has recommended seven strongly powered universities and scientific research institution as the foresaid training organizations in China. In 2005, MEP (NNSA) invited IAEA experts to help build the competence of teachers with these seven organizations. Led by MEP (NNSA), these training organizations have compiled and published unified training textbooks and syllabus, and set up a test pool. To serve different trainees, trainings have three levels, elementary, medium and advanced. Training organizations recommended by MEP (NNSA) may offer all three levels of trainings, while ones recommended by provincial governments can only provide elementary-levelled training. These trainings include also emergency preparedness.

At the national level, the response is managed by the National Coordination Committee for Nuclear Accidents Emergency (NCCNE) whose members among others are representatives of the; MII (CAEA), MEP (NNSA); the MoH; the State Meteorology Administration and other 15 member institutions.

The national intervention levels for taking urgent protective actions are adopted as safety guides: Intervention Principles and Levels of Public Protection in Times of Nuclear Incidents and Radiation Emergencies (HAD002/03) (1991, rev. 2004, MEP (NNSA) and MOH and CAEA). Following this guide, operational intervention levels are proposed by the NPP. MEP (NNSA) verifies if the proposal is coherent with national intervention levels intervention levels. In case of an emergency NNSA verifies if licensee performed in accordance with the determined operational intervention levels. This is done by the resident inspector who is sent to the place immediately after the emergency situation appears.

IRRS Review Team was informed that emergency planning zones (EPZ) in China are determined on the basis of Implementation Rules for the Regulations on Nuclear Accident Emergency Management for Nuclear Power Plants (I) - Emergency Preparedness and Response for Nuclear Power Plant Operators (HAF002/01) (1998, NNSA). Thus, the applicant for the NPP submits the proposal of EPZ based on its calculations and assessments. This proposal is included in Preliminary Safety Analysis Report, on-site emergency plan and is a part of the licensing documentation for the NPP first fuel load. The local authority, i.e. the Commission of Nuclear Emergency Response of the province at which the NPP is located, then determines the shape of the EPZ. The applicant for the NPP is responsible for formulating the protective measures recommendations in EPZ while NNSA can assist if requested.

Intervention doses received by emergency workers are managed in a different way on-site and off-site. MEP (NNSA) requires NPP to report records of emergency workers, as NPP is required to control in

accordance with the intervention guidelines. Off-site - as the local government does the first response, such responsibility must rest with local government. Generally the doses are health question, i. e. this is the responsibility of MOH. The IRRS Review Team was informed by representatives of MOH that no special general arrangements are adopted with regard to the management of the emergency workers doses received by an intervention. MEP (NNSA) requires NPP to report records of emergency workers, as NPP is required to control in accordance with the intervention guidelines. The regulations apply nationally, hence the MEP (NNSA) has set the framework, even if they don't actively manage adherence to it during the emergency.

RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES	
(1)	**BASIS**: **GS-R-2 §4.60 states that** *"National guidance that is in accordance with international standards shall be adopted for managing, controlling and recording the doses received by emergency workers. This guidance shall include default operational levels of dose for emergency workers for different types of response activities, which are set in quantities that can be directly monitored during the performance of these activities (such as the integrated dose from external penetrating radiation). In setting the default operational levels of dose for emergency workers the contribution to doses via all exposure pathways shall be taken into account."*
(2)	**BASIS: GS-R-2 §4.62 states that** *"Arrangements shall be made for taking all practicable measures to provide protection for emergency workers for the range of anticipated hazardous conditions in which they may have to perform response functions on or off the site. This shall include: arrangements to assess continually and to record the doses received by emergency workers; procedures to ensure that doses received and contamination are controlled in accordance with established guidance and international standards; and arrangements for the provision of appropriate specialized protective equipment, procedures and training for emergency response in the anticipated hazardous conditions."*
R40	**Recommendation: MEP (NNSA) and MOH should ensure managing, controlling and recording the doses received by emergency workers for different types of response activities.**

All the above introduced information was discussed and the following conclusions were made by the IRRS:

- the response on the national level managed by the NCCNE while on the local/provincial level by the respective local/provincial commissions;
- the responsibility of the protective measures implementation is with the local authorities while the recommendation should be done by the NPP; the NNSA is responsible for advise if requested;
- emergency plans are in place at both the national and local government level for nuclear power plants and radioactive sources workplaces;
- EPZ around NPPs are being determined;
- intervention levels are regulated but on the different legal levels for nuclear facilities and for radioactive sources practices; and
- the doses of intervening persons received during a response are not managed.

Integrated Regulatory Review Service to China

18-30 July,2010

APPENDIX I – LIST OF PARTICIPANTS

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APPENDIX II – MISSION PROGRAMME

IRRS MISSION PROGRAMME		
Sunday, 18 July 2010		
IRRS Opening IRRS Review Team Meeting		
14:00 - 18:00	Opening Remarks by the IRRS Team Leader (Mr. Weightman) Introduction by Mike Weightman, and Shahid Mallick Self-introduction of all Attendees Introductory words by Liaison Officer. Presentation on the IRRS Methodology (Mr. Caruso) Presentation on Reporting (Mr. Suman) Presentation Mission conduct/review (Mr. Weightman) First Impression from experts arising from the Advanced Reference Material (ARMS)	
Monday, 19 July 2010		
IRRS Entrance Meeting		
09:30 - 17:00	Opening Remarks by Mr Li Ganjie Opening Remarks by the IRRS Team Leader Mr Weightman Self-Introductory of the IRRS Review Team IRRS Team Leader presentation on the Chinese IRRS Process and Objective Counterpart Presentations: Overview of the Chinese regulatory approach - Introduction of 10 Modules	
18:00 - 19:00	Daily IRRS Review Team Meeting	
19:00 -	Official Dinner	
Tuesday, 20 July 2010		
Daily Discussions / Interviews		
09:00 – 18:00	Interviews and Discussions with Counterparts (Parallel discussions)	
18:00 – 19:00	Daily IRRS Review Team Meeting	
19:00	Travel to remote sites for some team members	
Wednesday, 21 July 2010		
Daily Discussions / Interviews		
09:00 – 18:00	Follow-up interviews and discussions with counterparts for all modules	
09:00 – 18:00	Site Visits Group 1 and 5 ***Site visit no. 1****: Visit to RR (Tsinghua University, Beijing, Chang Ping)* *(Group 2 – I. Lux and S. Koenick)* ***Site visit no. 5****: Visit to Radiation Devices (Tianjin JPY Ion-Tech. Co. LTD, Tianjin)* *(Group 5 – B. Cassels, M. Markkanen and H. Suman)*	
18:00 – 19:00	Daily IRRS Review Team Meeting	
Thursday, 22 July 2010		
Daily Discussions / Interviews		
09:00 – 18:00	Interviews: VM. NSC DG, CAEA DDG, NEA Department DG, CGNPC	

IRRS MISSION PROGRAMME		
	(NPP Team) CNNC, Head of Advisory Committee Ministry of Health	
09:00 – 18:00	Site Visits Group 2, 3, 4, 6 and 7 **22-23 July 2010** ***Site visit No. 2****: Visit to Fuel Cycle Facilities (Northern Nuclear Fuel Manufactory, Bao tou,)* *(Group 2 – I. Lux and S. Koenick)* ***Site visit No. 3****: Visit to NPP (china Qinshan NPP, Haiyan, Zhejiang)* *(Group 3 – L. Reiman and Y.H. Ryu)* ***Site visit no. 4****: Visit to Waste Management Facility (Guangdong Beilong Medium and Low Waste Disposal Facility, GuangDong, Shenzhen)* *(Group 6 – M. Vesterlind, P. Lietava and J. Rowat)* ***Site visit no. 6****: Visit to Medical Source(* Peking Union Medical College Hospital *)* *(Group 5 – B. Cassels, M. Karkkanen and H. Suman)* ***Site visit no. 7****: visit to Manufacturing (Shanghai Electornic Grop. CO. LTD. Shanghai)* *(Group 4 - O. Allain and S. Bozhko)*	
18:00 – 19:00	Daily IRRS Review Team Meeting	
Friday, 23 July 2010		
Daily Discussions / Interviews and Site Visits		
09:00 – 18:00	Continuation of interviews	
09:00 – 18:00	All day site visits Group 2, 3, 4, 5 and 6	
Saturday, 24 July 2010		
Daily Discussions		
09:00 – 18:00	Travel from remote sites for some team members	
09:00 – 18:00	Report writing	
Sunday, 25 July 2010		
Daily Discussions		
09:00 – 18:00	Sightseeing and Lunch	
Monday, 26 July 2010		
Daily Discussions		
09:00 – 12:00	Continuation with discussions with counterparts	
13:00-18:00	Policy Issue discussion *1) Regulatory Oversight during Construction of Nuclear Power Plants* *2) Human Resources and Knowledge Management at the regulatory body* *3) International Cooperation and Collaboration of the regulatory body*	
18:00 – 19:00	Daily IRRS Review Team Meeting	
Tuesday, 27 July 2010		
Daily Discussions		
09:00 – 10:00	Finalization of discussions with counterparts	
10:00-16:00	Finalize Mission Report	
18:00 – 19:00	Daily IRRS Review Team Meeting	
Wednesday, 28 July 2010		

IRRS MISSION PROGRAMME		
Review of Mission report and, mission report handover		
09:00 – 16:00	Finalizing Mission Report	
16:00	Handover of Draft IRRS Mission report to MEP (NNSA) for review and comments	
Thursday, 29 July 2010		
Plenary Session and Preparation for the exit meeting		
09:00 – 18:00	Discussion MEP (NNSA) comments (all IRRS Review Team)	
	Preparation for Press Release (IAEA press officer)	
18:00	Official Dinner	
Friday, 30 July 2010		
EXIT MEETING and PRESS CONFERENCE		
09:00 – 12:00	Finalize Press Release	
12:00 -	IRRS Exit Meeting (Speakers: Mr. Li Ganjie, Team Leader and Mr. Taniguchi DDG-NS)	

APPENDIX III – SITE VISITS

SITE VISITS	
1.	**Site visit to Research Reactor**
	Tsinghua University, Beijing, Chang Ping
2.	**Site visit to Fuel Cycle Facilities**
	Northen Nuclear Fuel Manufactory , Bao Tou,Nei Meng
3.	**Site visit to Nuclear Power Plant**
	Qinshan Nuclear Power Plan Hai Yan, Zhe Jiang
4.	**Site visit to Waste Management Facility**
	Guangdong Beilong Medium and Low lever Waste Disposal Facility, Shenzhen, GuangDong
5.	**Site visit to Radiation Devices**
	Tianjin JPY Ion-Tech .Co. LTD, Tianjin
6.	**Site visit to Medical Source**
	Peking Union Medical College Hospital
7.	**Site visit to Manufacturing**
	Shanghai Electric Group, Shanghai

APPENDIX IV – LIST OF COUNTERPARTS

	AREAS	IRRS EXPERTS	NNSA Counterpart	Support Counterpart
1.	**RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT**			
		☐ Mr. M. Weightman ☐ Mr. S. Mallick ☐ Mr. K. Nakamura ☐ Mr. G. Clapisson ☐ Mr. A. Stritar ☐ Mr. G. Caruso	☐ Mr. LIU Hua ☐ Mr. JIANG Guang ☐ Mr. YU Jun ☐ Mr. JIANG Wei ☐ Mr. ZHAO Yongming ☐ Mr. LI Jingxi ☐ Mr. PENG Jun ☐ Mr. HU Liguang	☐ Mr. TIAN Jiashu ☐ Mr. LAN Ziyong
2.	**GLOBAL NUCLEAR SAFETY RÉGIME**			
		☐ Mr. M. Weightman ☐ Mr. S. Mallick ☐ Mr. K. Nakamura ☐ Mr. G. Clapisson ☐ Mr. A. Stritar ☐ Mr. G. Caruso	☐ Mr. LIU Hua ☐ Mr. JIANG Guang ☐ Mr. YU Jun ☐ Mr. JIANG Wei ☐ Mr. ZHAO Yongming ☐ Mr. LI Jingxi ☐ Mr. PENG Jun ☐ Mr. HU Liguang	☐ Mr. TIAN Jiashu ☐ Mr. LAN Ziyong
3.	**RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY**			
		☐ Mr. M. Weightman ☐ Mr. S. Mallick ☐ Mr. K. Nakamura ☐ Mr. G. Clapisson ☐ Mr. A. Stritar ☐ Mr. G. Caruso	☐ Mr. LIU Hua ☐ Mr. JIANG Guang ☐ Mr. YU Jun ☐ Mr. JIANG Wei ☐ Mr. ZHAO Yongming ☐ Mr. LI Jingxi ☐ Mr. PENG Jun ☐ Mr. HU Liguang	☐ Mr. TIAN Jiashu ☐ Mr. LAN Ziyong

	AREAS	IRRS EXPERTS	NNSA Counterpart	Support Counterpart
4.	**MANAGEMENT SYSTEM OF THE REGULATORY BODY**			
		☐ Mr. M. Weightman ☐ Mr. S. Mallick ☐ Mr. K. Nakamura ☐ Mr. G. Clapisson ☐ Mr. A. Stritar ☐ Mr. G. Caruso	☐ Mr. LIU Hua ☐ Mr. JIANG Guang ☐ Mr. YU Jun ☐ Mr. JIANG Wei ☐ Mr. ZHAO Yongming ☐ Mr. LI Jingxi ☐ Mr. PENG Jun ☐ Mr. HU Liguang	☐ Mr. TIAN Jiashu ☐ Mr. LAN Ziyong
5.	**AUTHORIZATION**			
	Nuclear Power Plants	☐ Mr. L. Reiman ☐ Mr. Y.H. Ryu	☐ Mr. ZHOU Shirong ☐ Mr. HAO Xiaofeng ☐ Mr. LI Jigen	☐ Mr. SHANG Zhaorong ☐ Mr. CHAI Guohan ☐ Mr. YANG Di
	Research Reactors	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. HOU Wei ☐ Mr. SONG Chenxiu ☐ Mr. ZHENG Weibo	
	Fuel Cycle Facilities	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. PAN Su ☐ Mr. SHAO Mingchang	☐ Mr. KANG Yufeng ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
	Industrial, Medical and Research Facilities	☐ Mr. B. Cassels ☐ Mr. M. Markkanen ☐ Mr. H. Suman (IAEA)	☐ Mr. LIU Yigang ☐ Mr. ZHANG Jiali	☐ Mr. ZHOU Qifu ☐ Ms. MAO Yahong ☐ Mr. CHEN Dongliang ☐ Mr. WANG Nan ☐ Mr. YANG Yaoyun
	Waste Facilities	☐ Mr. P. Lietava ☐ Mr. M. Vesterlind ☐ Mr. J. Rowat (IAEA)	☐ Mr. MA Chenghui ☐ Mr. KONG Xiangjin	☐ Mr. KANG Yufeng ☐ Mr. FAN Zhiwen ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
6.	**REVIEW AND ASSESSMENT**			

	AREAS	IRRS EXPERTS	NNSA Counterpart	Support Counterpart
	Nuclear Power Plants	☐ Mr. L. Reiman ☐ Mr. Y.H. Ryu	☐ Mr. ZHOU Shirong ☐ Mr. HAO Xiaofeng ☐ Mr. LI Jigen	☐ Mr. SHANG Zhaorong ☐ Mr. CHAI Guohan ☐ Mr. YANG Di
	Research Reactors	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. HOU Wei ☐ Mr. SONG Chenxiu ☐ Mr. ZHENG Weibo	
	Fuel Cycle Facilities	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. PAN Su ☐ Mr. SHAO Mingchang	☐ Mr. KANG Yufeng ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
	Industrial, Medical and Research Facilities	☐ Mr. B. Cassels ☐ Mr. M. Markkanen ☐ Mr. H. Suman (IAEA)	☐ Mr. LIU Yigang ☐ Mr. ZHANG Jiali	☐ Mr. ZHOU Qifu ☐ Ms. MAO Yahong ☐ Mr. CHEN Dongliang ☐ Mr. WANG Nan ☐ Mr. YANG Yaoyun
	Waste Facilities	☐ Mr. P. Lietava ☐ Mr. M. Vesterlind ☐ Mr. J. Rowat (IAEA)	☐ Mr. MA Chenghui ☐ Mr. KONG Xiangjin	☐ Mr. KANG Yufeng ☐ Mr. FAN Zhiwen ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
7.	**INSPECTION**			
	Nuclear Power Plants	☐ Mr. F. Rinfret ☐ Mr. B. Mallet ☐ Mr. O. Allain ☐ Mr. S. Bozhko	☐ Mr. LI Jingxi ☐ MS. LIU Lu ☐ Mr. ZHU Zhibin ☐ Mr. FU Qiang	☐ Mr. YANG Tianwen ☐ Mr. LANG Aiguo ☐ Mr. LI Zongming
	Research Reactors	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. HOU Wei ☐ Mr. SONG Chenxiu ☐ Mr. ZHENG Weibo	
	Fuel Cycle Facilities	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. PAN Su ☐ Mr. SHAO Mingchang	☐ Mr. KANG Yufeng ☐ Mr. WU Hao ☐ Mr. LIU Xinhua

	AREAS	IRRS EXPERTS	NNSA Counterpart	Support Counterpart
	Industrial, Medical and Research Facilities	☐ Mr. B. Cassels ☐ Mr. M. Markkanen ☐ Mr. H. Suman (IAEA)	☐ Mr. LIU Yigang ☐ Mr. ZHANG Jiali	☐ Mr. ZHOU Qifu ☐ Ms. MAO Yahong ☐ Mr. CHEN Dongliang ☐ Mr. WANG Nan ☐ Mr. YANG Yaoyun
	Waste Facilities	☐ Mr. P. Lietava ☐ Mr. M. Vesterlind ☐ Mr. J. Rowat (IAEA)	☐ Mr. MA Chenghui ☐ Mr. KONG Xiangjin	☐ Mr. KANG Yufeng ☐ Mr. FAN Zhiwen ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
8.	**ENFORCEMENT**			
	Nuclear Power Plants	☐ Mr. F. Rinfret ☐ Mr. B. Mallet ☐ Mr. O. Allain ☐ Mr. S. Bozhko	☐ Mr.JIANG Guang Mr. LI Jingxi ☐ Ms. LIU Lu ☐ Mr. ZHU Zhibin ☐ Mr. FU Qiang	☐ Mr. YANG Tianwen ☐ Mr. LANG Aiguo ☐ Mr. LI Zongming
	Research Reactors	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr.JIANG Guang ☐ Mr. HOU Wei ☐ Mr. SONG Chenxiu ☐ Mr. ZHENG Weibo	
	Fuel Cycle Facilities	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr.JIANG Guang ☐ Mr. PAN Su ☐ Mr. SHAO Mingchang	☐ Mr. KANG Yufeng ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
	Industrial, Medical and Research Facilities	☐ Mr. B. Cassels ☐ Mr. M. Markkanen ☐ Mr. H. Suman (IAEA)	☐ Mr.JIANG Guang ☐ Mr. LIU Yigang ☐ Mr. ZHANG Jiali	☐ Mr. ZHOU Qifu ☐ Ms. MAO Yahong ☐ Mr. CHEN Dongliang ☐ Mr. WANG Nan ☐ Mr. YANG Yaoyun
	Waste Facilities	☐ Mr. P. Lietava ☐ Mr. M. Vesterlind ☐ Mr. J. Rowat (IAEA)	☐ Mr.JIANG Guang ☐ Mr. MA Chenghui ☐ Mr. KONG Xiangjin	☐ Mr. KANG Yufeng ☐ Mr. FAN Zhiwen ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
9.	**REGULATIONS AND GUIDES**			

	AREAS	IRRS EXPERTS	NNSA Counterpart	Support Counterpart
	Nuclear Power Plants	☐ Mr. L. Reiman ☐ Mr. Y.H. Ryu	☐ Mr. ZHOU Shirong ☐ Mr. HAO Xiaofeng ☐ Mr. LI Jigen	☐ Mr. SHANG Zhaorong ☐ Mr. CHAI Guohan ☐ Mr. YANG Di
	Research Reactors	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. HOU Wei ☐ Mr. SONG Chenxiu ☐ Mr. ZHENG Weibo	
	Fuel Cycle Facilities	☐ Mr. I. Lux ☐ Mr. S. Koenick (IAEA)	☐ Mr. PAN Su ☐ Mr. SHAO Mingchang	☐ Mr. KANG Yufeng ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
	Industrial, Medical and Research Facilities	☐ Mr. B. Cassels ☐ Mr. M. Markkanen ☐ Mr. H. Suman (IAEA)	☐ Mr. LIU Yigang ☐ Mr. ZHANG Jiali	☐ Mr. ZHOU Qifu ☐ Ms. MAO Yahong ☐ Mr. CHEN Dongliang ☐ Mr. WANG Nan ☐ Mr. YANG Yaoyun
	Waste Facilities	☐ Mr. P. Lietava ☐ Mr. M. Vesterlind ☐ Mr. J. Rowat (IAEA)	☐ Mr. MA Chenghui ☐ Mr. KONG Xiangjin	☐ Mr. KANG Yufeng ☐ Mr. FAN Zhiwen ☐ Mr. WU Hao ☐ Mr. LIU Xinhua
10.	**EMERGENCY PREPAREDNESS AND RESPONSE**			
		☐ Ms. V. Starostova	☐ Mr. CHAO Zhexiong ☐ Mr. DING Zhibo	☐ Mr. CHEN Xiaoqiu ☐ Mr. YUE Huiguo ☐ Ms. YANG Ling

APPENDIX V – RECOMMENDATIONS, SUGGESTIONS AND GOOD PRACTICES

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
1. RESPONSIBILITIES AND FUNCTIONS OF THE GOVERNMENT	R1	**Recommendation: The government/MEP (NNSA) should compile one document as soon as practicable, in which an expanded nuclear policy and strategy for safety that covers compliance with the ten safety principles as given in IAEA Safety Fundamentals (SF-1) should be included, taking account the current and future challenges faced by the government, regulatory body and the industry.**
	S1	**Suggestion: The MEP (NNSA) should consider enhancing the application of the graded approach in the implementation of the national policy and strategy for safety.**
	GP1	**Good Practice: The long term (2005-2020) nuclear power development plan issued in October 2007 and the long term (2006-2020) plan on nuclear safety and radioactive pollution prevention issued in October 2007, include a clear nuclear policy statement – adhere to the "safety first/quality first principle", and a commitment to strengthen the supervision of nuclear safety and its enforcement.**
	R2	**Recommendation: The government should expedite the promulgations of nuclear laws such as Atomic Energy Act and Nuclear Safety Act, consolidating and updating the nuclear safety infrastructure in China in such a way that it complies with GSR Part 1 requirements taking account of the rapid development of the nuclear power programme. Efforts should be made to complete the promulgations process within a reasonable time frame.**
	S2	**Suggestion: The regulatory authorities should ensure that in the implementation of regulations covering the Basic Safety Standard**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		there is no gaps or unnecessary overlaps in assessment, inspection and enforcement.
	S3	**Suggestion: The government should adequately strengthen institutions to respond to the development of the nuclear laws and associated regulations.**
	GP2	**Good Practice: MEP (NNSA) has made available the basic conditions covering, inter alia, organisational, resource and safety culture factors for companies wishing to acquire a licence to have access to Chinese nuclear markets.**
	R3	**Recommendation: In effectively responding to the increasing safety challenges of rapid development of nuclear power, the government should strengthen the NNSA as a real integrated regulatory Authority (Administration or Agency) within the MEP with a Vice Minister as its Administrator and Head mainly focused on safety regulation, so as to enable the MEP (NNSA) to mobilize and use management resources in more efficient and intensive way**.
	R4	**Recommendation: The Government should allocate adequate financial and human resources, of the appropriate competencies, for developing and maintaining the regulatory infrastructure in China commensurate with the current and the rapid development of its nuclear power programme.**
	R5	**Recommendation: The Government should provide MEP (NNSA) with sufficient flexibility, to ensure that the regulatory body can attract and retain the suitably qualified and experienced regulatory staff that it will require.**
	R6	**Recommendation: Although the current regulations assign the prime responsibility for nuclear safety to the organization responsible for the facilities or activities, this requirement should**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		also be clearly defined in the new laws to be promulgated.
	S4	**Suggestion: The new Law on Nuclear Safety should include a clear commitment for the maintenance of the prime responsibility for safety in line with GSR Part 1 Requirement 6.**
	R7	**Recommendation: The regulatory authorities should establish mechanisms for the effective coordination of the regulatory functions on occupational radiation protection, including ALARA applications, amongst MOH, provincial DoH, MEP and provincial EPB to ensure complete and clear coverage and coordination.**
	R8	**Recommendation: The government should establish a comprehensive national policy and strategy for the management of radioactive waste and spent nuclear fuel.**
	S5	**Suggestion: The government should establish one agency responsible for the implementation of the national strategy for disposal of radioactive waste.**
	S6	**Suggestion: When regulations or the law on prevention and control of radioactive pollution are amended, it should be made explicit that storage facilities for radioactive waste are defined as nuclear installations.**
	S7	**Suggestion: The government should develop the national human resources development plan as an integral part of the five years national nuclear power programme strategic plan.**
	S8	**Suggestion: The MEP (NNSA) may consider expanding the system of recommendations for training organizations to all professional areas relevant to nuclear safety.**
	GP3	**Good Practice: The MEP (NNSA) recommendations for universities and other training of engineers in some professional**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		areas is very useful.
	GP4	**Good Practice: The qualification and registration of nuclear safety engineers in China is considered a good practice**
2. GLOBAL NUCLEAR SAFETY REGIME	R9	**Recommendation: MEP (NNSA) should be provided with adequate resources and flexibility for international cooperation, especially taking into account the nature of some of the new designs of nuclear power plants which originate from abroad.**
	S9	**Suggestion : MEP (NNSA) should have its own line of communication/interaction with the IAEA.**
	R10	**Recommendation: MEP (NNSA) should take over the role of national IRS coordinator, and act as the prime link into the Asian Nuclear Safety Network (ANSN).**
3. RESPONSIBILITIES AND FUNCTIONS OF THE REGULATORY BODY	R11	**Recommendation: In the circumstances of MEP (NNSA) becoming a real integrated body, to maximize regulatory effectiveness it should be organized with a clearer and more efficient line management structure where responsibilities are well defined and understood by everybody involved, ensuring that regional offices report to one coordinating body within the NNSA.**
	R12	**Recommendation: MEP (NNSA) should develop and implement an integrated human resource management programme, in particular technical competence including knowledge management and systematic approach to training, commensurate with the needs to fulfil their regulatory responsibilities taking into account the current and the rapid nuclear power development programme of China. The ability for MEP (NNSA) to address this recommendation would be facilitated by the government addressing recommendations 4 and 5.**
	R13	**Recommendation: MEP (NNSA) should make formal**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		arrangement with Technical Support Organizations that they are using to ensure that there is no conflict of interest. Also the potential for conflict of interest within the subcontractors used by the TSOs should be periodically assessed by NNSA.
	S10	**Suggestion: The MEP (NNSA) should continue regulatory liaison arrangements with authorized facilities.**
	R14	**Recommendation: The authorities involved in the regulatory body should enhance their information management to ensure proper information recording, analysing and dissemination to the relevant stakeholders (including the international organization) in a timely manner.**
	S11	**Suggestion: MEP (NNSA) should consider strengthening its arrangements for document management, record keeping and long-term retrievable storage in accordance with the management system.**
	S12	**Suggestion: MEP (NNSA) should consider holding meetings with the residents and representatives of the public of the areas around the operating facilities to explain their work and decisions.**
4. MANAGEMENT SYSTEM OF THE REGULATORY BODY	R15	**Recommendation: MEP (NNSA) should establish and implement an integrated management system in conformance with IAEA SS GS-R-3.**
5. AUTHORIZATION	GP5	**Good Practice: The authorization procedures and regulations concerning nuclear safety equipment manufactured in China have been developed in recent years. The regulatory supervision has been strengthened and is organized in an effective way.**
	R17	**Recommendation: MEP (NNSA) should make explicit requirements in revising the relevant code to ensure that applications submitted by the licensee that contain safety**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		analyses results shall be verified by experts independent from those that were involved in the preparation of the application, reflecting existing practices.
	S14	**Suggestion: Acknowledging that MEP (NNSA) regulates all research reactors as in operational status, it should consider elaboration of regulations on the design and maintenance requirements related to the extended shutdown state of research reactors and critical assemblies.**
	S15	**Suggestion: MEP (NNSA) should consider applying a graded approach in a carefully balanced manner to regulatory control over the various fuel cycle facilities, and this control should be commensurate with the potential hazard the facilities represent.**
	S16	**Suggestion: With the increase in need for nuclear fuel cycle facilities in the future, MEP (NNSA) should consider whether it needs more formal means to achieve confidence in contractor qualifications having influence on the safe operation of fuel cycle facilities.**
	S17	**Suggestion: MEP (NNSA) should consider the elaboration of a procedure/programme for systematic supervision of the qualification and training of fuel cycle facility personnel.**
	S18	**Suggestion: The MEP (NNSA) should consider ensuring that the provisions of the Guidance on Import and Export of Radioactive Sources are fully followed, as far as practicable.**
	R18	**Recommendation: The regulatory body should establish requirements for financial provisions for the safe management of disused sources.**
	S19	**Suggestion: The regulatory body should consider enhancing the implementation of the graded approach by adjusting the authorization process according to the category of the sources.**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
	R19	**Recommendation: MEP (NNSA) should establish a formal legal requirement to have a waste minimization plan as part of the application for a license.**
	S20	**Suggestion: MEP (NNSA) should encourage the operator of the Beilong Disposal Facility to apply for an operating licence for the facility, be that as a disposal facility or as a storage facility. The current temporary operating permit is not a sustainable situation.**
6. REVIEW AND ASSESSMENT	R20	**Recommendation: The headquarter MEP (NNSA) should assess its current and future needs for internal technical expertise considering especially its decision-making functions.**
	S21	**Suggestion: NNSA should perform appropriate conformational analysis and verification for nuclear facilities accident analyses in the construction license phase, where possible acquiring adequate tools.**
	R21	**Recommendation: In developing safety guides, regulations and Evaluation Principles MEP (NNSA) should ensure that there are no conflicts.**
	S22	**Suggestion: The MEP (NNSA) should consider developing guidance concerning the use of PSA for key applications, and should consider starting to risk-inform its own regulatory functions to optimize regulatory activities and develop an implementation programme for that purpose.**
	GP6	**Good practices: The MEP (NNSA) supports the wide use of PSA by issuing a PSA Policy Statement.**
	S23	**Suggestion: The MEP (NNSA) should consider ensuring that they have adequate capability to review human factors and safety culture related issues in the light of the nuclear industry expansion.**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
	R22	**Recommendation: MEP (NNSA) should require the updating of the SAR of fuel cycle facilities on a regular basis as well as following important modifications that have an effect on the safety of the installation.**
	R23	**Recommendation: MEP (NNSA) should make the necessary steps to provide adequate resources in order to make it able to perform all the assessment and review work necessary to support the MEP (NNSA)'s regulatory supervision of fuel cycle facilities, especially for spent fuel facilities. Analyses provided by organizations outside of the regulatory body should be ensured to be independent of the nuclear operators.**
	S24	**Suggestion: MEP (NNSA) should consider setting requirements on the frequency of the periodic safety review of fuel cycle facilities and the issuance of regulatory guidance on periodic safety reviews for fuel cycle facilities.**
	S25	**Suggestion: The MEP (NNSA) should consider to establish procedures for formal recognition of external experts in the field of radiation protection.**
7. INSPECTION	S26	**Suggestion: MEP (NNSA) should enhance its training programme for inspectors and experts; the enhancement would provide knowledge and experience in all areas of safety, security, radiation protection and the environment that inspectors oversee during the lifecycle of the plant.**
	GP7	**Good Practice: The MEP (NNSA) training programme for inspectors includes simplified reactor behaviour simulation training as well as licensee provided material on site equipment and systems.**
	R24	**Recommendation: MEP (NNSA) should enhance the process of review, analysis and sharing of operating experiences. This includes sharing of experience amongst the regions. This process**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		should include appropriate means of sharing information amongst the regulatory body and operating organizations. The regulatory body should consider the development of a database to facilitate management of follow up actions, trending, accessing to information as part of overall knowledge management.
	S27	**Suggestion: MEP (NNSA) should formalize a mentoring programme to build expert knowledge and skills of inspectors in order to aid the inspectors in areas which are not covered by procedures. This mentoring programme should extend beyond the initial inspector certification training programme.**
	S28	**Suggestion: MEP (NNSA) should look for ways to enhance the sharing of detailed inspection procedures and their application amongst the regional offices, especially for new construction inspections. Detailed inspection procedures would provide guidance on what to inspect from the significance perspective to inspectors without detailed technical expertise.**
	S29	**Suggestion: MEP (NNSA) inspectors should consider extending the scope of review of NPPs to include how the licensee manages technical processes and programmes in detail.**
	S30	**Suggestion: MEP (NNSA) should consider developing a database of inspection findings, to be shared within the entire NNSA.**
	S31	**Suggestion: MEP (NNSA) should continuously improve and implement the programme of safety performance indicators for utilities and ensure that staffs are trained in their use.**
	S32	**Suggestion: MEP (NNSA) should consider optimizing the practice of rotating resident inspectors among sites to allow sufficient time at one site in order to stabilize the experience level but not too long to suffer regulatory capture.**
	S33	**Suggestion: MEP (NNSA) should consider using technical**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		support organizations consistently to contribute to the development of site specific inspection guides.
	R25	**Recommendation: MEP (NNSA) should strengthen the auditing programme in foreign factories for quality assurance of equipment to be used in Chinese NPPs.**
	S34	**Suggestion: MEP (NNSA) should consider enhancing the sharing of major lessons learned from manufacturing experience with others.**
	GP8	**Good Practice: MEP (NNSA) has initiated periodic meetings between Chinese manufacturers to promote the exchange of important manufacturing information.**
	S35	**Suggestion: The regulatory body should ensure that the inspectors' competencies and inspection procedures are enhanced so that they recognize matters related to radiation safety and regulatory requirements if not included in their inspection checklists.**
	S36	**Suggestion: The regulatory body should consider optimizing the implementation of the graded approach by adjusting the inspection frequencies and process according to the category of the sources.**
	R26	**Recommendation: The regulatory body should ensure that due consideration is given to certain parameters and properties of waste which the operator does not appear to be reporting, namely:** **- a cumulative total of the nuclide specific inventory of the disposal facility,** **- important non-radiological properties of the waste.**
	R27	**Recommendation: The regulatory body should require the**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		operator to strengthen their programme for radiation protection monitoring of the controlled area at the Beilong disposal facility.
8. ENFORCEMENT	R28	**Recommendation: Periodically the regulatory body should collect, analyse and disseminate information on non-compliances and enforcement actions, in particular to provide feedback to enhance the performance of the regulatory functions.**
	R29	**Recommendation: Consideration should be given for the involvement of all authorities comprising the regulatory body in the completion of the enforcement guide.**
	S37	**Suggestion: Consideration should be given to include risk-based grading in the implementation of the enforcement policy for radioactive sources.**
9. REGULATIONS AND GUIDES	R30	**Recommendation: The MEP (NNSA) should adopt a practice where all the regulations are reviewed on a regular basis.**
	S38	**Suggestion: The MEP (NNSA) should allocate sufficient resources and funding to the development of regulations and guides.**
	R31	**Recommendation: The MEP (NNSA) should follow a policy where, in the long run, the licensing of new nuclear power plants is based on existing regulations. The need to backfit operating plants to meet the regulations should be assessed first as new regulations are issued and then in connection with Periodic Safety Reviews. Backfitting concerning operating plants should be performed, based on these assessments, as found reasonably practicable.**
	R32	**Recommendation: MEP (NNSA) should revise its regulations on research reactors and critical assemblies in order to formulate requirements in compliance with the IAEA safety requirements in NS-R-4 where they exist and as far as reasonably practicable.**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
	S39	**Suggestion: In order to facilitate the issuance and application of the Department Rule under revision MEP (NNSA) should initiate the elaboration of related regulatory guides without waiting for issuance of the IAEA guidance.**
	R33	**Recommendation: MEP (NNSA) should revise its regulations on fuel cycle facilities in order to formulate requirements in compliance with the IAEA safety requirements in NS-R-5 where they exist and as far as are reasonably practicable.**
	S40	**Suggestion: In order to facilitate the issuance and application of any such revision to regulations, MEP (NNSA) should initiate the elaboration of related regulatory guides.**
	R34	**Recommendation: MEP (NNSA) should finalize, approve and implement draft documents on 'Implementation Rule for Safety and Protection management of radioisotopes and radiation-emitting devices'**
	R35	**Recommendation: MEP (NNSA) should finalize and implement the draft Rule related to radiation monitoring at scrap metal and smelting industry.**
	GP9	**Good Practice: The graded approach is implemented in accordance with a risk-based categorization of radioactive sources and radiation-emitting devices. For sealed sources, China has adopted the IAEA categorization of sources and extended it to unsealed sources and radiation-emitting equipment.**
	R36	**Recommendation: MEP (NNSA) should develop regulations for decommissioning plans covering:** • **When decommissioning plans should be drawn up;** • **Scope and content of the plan; and** • **Periodic revision of the plan.**

AREAS	R: Recommendations S: Suggestions G: Good Practices	Recommendations, Suggestions or Good Practices
		The regulations should cover decommissioning plans for existing as well as for planned nuclear installations.
	R37	**Recommendation: For the Legislative plan for the period 2010-2015,** MEP (NNSA) **should assign suitable priority to the development of the regulations and rules for radioactive waste management. The proposed suite of guides for radioactive waste management to be produced in the same period should be re-evaluated in light of the current plans for the development of the IAEA safety standards.**
EMERGENCY PREPAREDNESS AND RESPONSE	R38	**Recommendation: MEP (NNSA), MII/CAEA and NEA should promote the elaboration and approval of a legal and regulatory framework for an assessment of the threats by categorizing facilities and practices in accordance with the IAEA safety standards.**
	S41	**Suggestion: MEP (NNSA) should consider an improvement of existing training emergency preparedness programmes and education, namely for local/provincial environmental authorities (as first response organizations at the local/provincial level) to ensure that the personnel both at headquarters and at provinces have the comparable knowledge and skills.**
	R39	**Recommendation: MEP (NNSA) should establish a quality assurance programme to ensure a high degree of availability and reliability of all the supplies, equipment, communication systems and facilities necessary to perform the assigned response functions, namely at the Nuclear and Radiation Accident Emergency Technical Centre.**
	R40	**Recommendation: MEP (NNSA) and MOH should ensure managing, controlling and recording the doses received by emergency workers for different types of response activities.**

APPENDIX VI – MEP (NNSA) REFERENCE MATERIAL USED FOR THE REVIEW

IRRS Self-assessment Report on:

- ☐ *Regulation of Nuclear and Radiation Safety in China*

Regulations on:

- ☐ *Safety and Protection of Radioisotopes and Radiation-emitting Devices*
- ☐ *Supervision and Administration of Civilian Nuclear Safety Equipment*
- ☐ *the Nuclear Safety of the People's Republic of China*

IRRS Questionnaires on:

- ☐ *Common Questions*
- ☐ *Code of Conduct on the Safety and Security of Radioactive Sources*
- ☐ *Emergency Preparedness and Response*
- ☐ *Occupational Radiation Protection*
- ☐ *Public Exposure*
- ☐ *Waste Management*

Questionnaires on:

- ☐ *Safety of Fuel Cycle Facilities (DS316)*
- ☐ *Safety of Nuclear Power Plant Design (NS-R-1)*
- ☐ *Safety of Nuclear Power Plants Operation (NS-R-2)*
- ☐ *Safety of Research Reactors (NS-R-4)*

APPENDIX VII – IAEA REFERENCE MATERIAL USED FOR THE REVIEW

1. **IAEA SAFETY STANDARDS SERIES No. SF-1** - Fundamental Safety Principles
2. **IAEA SAFETY STANDARDS SERIES No. GSR PART 1** - Governmental, Legal and Regulatory Framework for Safety
3. **IAEA SAFETY STANDARDS SERIES No. GS-G-1.1** - Organization and Staffing of the Regulatory Body for Nuclear Facilities
4. **IAEA SAFETY STANDARDS SERIES No. GS-G-1.2 -** Review and Assessment of Nuclear Facilities by the Regulatory Body
5. **IAEA SAFETY STANDARDS SERIES No. GS-G-1.3 -** Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body
6. **IAEA SAFETY STANDARDS SERIES No. GS-G-1.4 -** Documentation for Use in Regulatory Nuclear
7. **IAEA SAFETY STANDARDS SERIES No. GS-G-1.5** - Regulatory Control of Radiation Sources
8. **IAEA SAFETY STANDARDS SERIES No. GS-R-2** - Preparedness and Response for a Nuclear or Radiological Emergency Safety Requirements
9. **IAEA SAFETY STANDARDS SERIES No. GS-R-3** - The Management System for Facilities and Activities
10. **IAEA SAFETY STANDARDS SERIES No. GS-G-3.1 -** Application of the Management System for Facilities and Activities
11. **IAEA SAFETY STANDARDS SERIES No. GS-G-3.3** - The Management System for the Processing, Handling and Storage of Radioactive Waste
12. **IAEA SAFETY STANDARDS SERIES No. GS-G-3.4** - The Management System for the Disposal of Radioactive Waste
13. **IAEA SAFETY STANDARDS SERIES No. GS-G-3.5** -
14. **IAEA SAFETY STANDARDS SERIES No. GSR Part 4** - Safety Assessment for Facilities and Activities
15. **IAEA SAFETY STANDARDS SERIES No. NS-R-1** - Safety of Nuclear Power Plants – Design Safety Requirements
16. **IAEA SAFETY STANDARDS SERIES No. NS-R-2** - Safety of Nuclear Power Plants – Operation Safety Requirements

17. **IAEA SAFETY STANDARDS SERIES No. NS-R-3** - Site Evaluation for Nuclear Installations Safety

18. **IAEA SAFETY STANDARDS SERIES No. NS-R-4** – Safety of Research Reactors

19. **IAEA SAFETY STANDARDS SERIES No. NS-R-5** – Safety of Nuclear Fuel Cycle Facilities

20. **IAEA SAFETY STANDARDS SERIES No.** SS115 - International Basic Safety standards for Protection against Ionizing Radiation and for the Safety of Radiation Sources

21. **IAEA SAFETY STANDARDS SERIES No. RS-G-1.7** - Application of the Concepts of Exclusion, Exemption and Clearance

22. **IAEA SAFETY STANDARDS SERIES No. RS-G-1.8** - Environmental and Source monitoring for Purpose of Radiation Protection

23. **IAEA SAFETY STANDARDS SERIES No. RS-G-1.9** - Categorization of Radioactive Sources,

24. **IAEA CODE OF CONDUCT** on the Safety and Security of Radioactive Sources

25. **IAEA GUIDANCE** on the Import and Export of Radioactive Sources

26. **IAEA SAFETY STANDARDS SERIES No. GSG 1** - Classification of Radioactive Waste

27. **IAEA SAFETY STANDARDS SERIES No. GSR Part 5** - Predisposal Management of Radioactive Waste

28. **IAEA SAFETY STANDARDS SERIES No. WS-R-1** - Near Surface Disposal of Radioactive Waste

29. **IAEA SAFETY STANDARDS SERIES No. WS-G-1.1** - Safety Assessment for Near Surface Disposal of Radioactive Waste

30. **IAEA SAFETY STANDARDS SERIES No. WS-G-1.2** - Management of Radioactive Waste from the Mining and Milling of Ores

31. **IAEA SAFETY STANDARDS SERIES No. WS-G-2.1** - Decommissioning of Nuclear Power Plants and Research Reactors

32. **IAEA SAFETY STANDARDS SERIES No. WS-G-2.2** - Decommissioning of Medical, Industrial and Research Facilities

33. **IAEA SAFETY STANDARDS SERIES No. WS-G-2.3** - Regulatory Control of Radioactive Discharges to the Environment

34. **IAEA SAFETY STANDARDS SERIES No. WS-G-2.4** - Decommissioning of Nuclear Fuel Cycle Facilities

35. **IAEA SAFETY STANDARDS SERIES No. WS-G-2.5** - Predisposal Management of Low and Intermediate Level Radioactive Waste

36. **IAEA SAFETY STANDARDS SERIES No. WS-G-2.6** - Predisposal Management of High Level Radioactive Waste

37. **IAEA SAFETY STANDARDS SERIES No. WS-G-2.7** - Management of Waste from the Use of Radioactive Material in Medicine, Industry, Agriculture, Research and Education

38. **IAEA SAFETY STANDARDS SERIES No. WS-R-3** - Remediation of Areas Contaminated by Past Activities and Accidents

39. **IAEA SAFETY STANDARDS SERIES No. WS-G-3.1** - Remediation Process for Areas Affected by Past Activities and Accidents

40. **IAEA SAFETY STANDARDS SERIES No. WS-R-4** - Geological Disposal of Radioactive Waste

41. **IAEA SAFETY STANDARDS SERIES No. WS-R-5** - Decommissioning of Facilities Using Radioactive Material

42. **IAEA SAFETY STANDARDS SERIES No. WS-G-5.1** - Release of Sites from Regulatory Control on Termination of Practices

43. **IAEA SAFETY STANDARDS SERIES No. WS-G-5.2** - Safety Assessment for the Decommissioning of Facilities Using Radioactive Material

44. **IAEA SAFETY STANDARDS SERIES No. WS-G-6.1** - Storage of Radioactive Waste

APPENDIX VIII – ORGANIZATIONAL CHART MEP (NNSA)