Working material

OSART Mission Highlights 2016-2018

Operational safety practices in nuclear power plants

The originating section of this report in the IAEA is:

Operational Safety Section
International Atomic Energy Agency
Wagramer Strasse 5
P.O. Box 100
1400 Vienna
Austria

FOREWORD

The IAEA Operational Safety Review Team (OSART) programme provides advice and assistance to Member States in enhancing the operational safety of Nuclear Power Plants (NPPs). Careful design and high quality of construction are prerequisites for a safe Nuclear Power Plant. However, a plant's safety depends ultimately on the ability and conscientiousness of the operating personnel and on the plant programmes, processes and working methods. An OSART Mission reviews a facility's operational performance against IAEA Safety Standards and proven good international practices.

OSART reviews are available to all countries with nuclear power plants in operation, and also approaching operation, commissioning or in earlier stages of construction (Pre-OSART). Most countries have participated in the programme by hosting one or more OSART Missions or by making experts available to participate in missions. Operational safety missions can also be part of the design review missions of nuclear power plants and are known as Safety Review Missions (SRMs). Teams that review only a few specific areas or a specific issue are called Expert missions. Follow-up visits are a standard part of the OSART programme and are conducted between 12 and 18 months following the OSART Mission.

This report continues the practice of summarizing mission results so that all the aspects of OSART Missions are gathered in one publication. It also includes the results of follow-up visits. This report highlights the most significant findings while retaining as much of the vital background information as possible. This report is divided in two main sections.

Chapter 1 summarizes the most significant observations made during the missions and follow-up visits between 2016 and 2018. Chapter 2 describes the common issues and good practices that were identified in the period covered. Chapter 3 describes the assessment of overall OSART Mission including follow-up results.

Chapter 1,2 and 3 of the report are intended for different levels of management in the operating and regulatory organizations respectively. Chapter 1 and 3 is primarily directed at the executive management level, Chapter 2 at middle managers and those involved in operational experience feedback. Individual findings varied considerably in scope and significance. However, the findings do reflect some common strengths and opportunities for improvement.

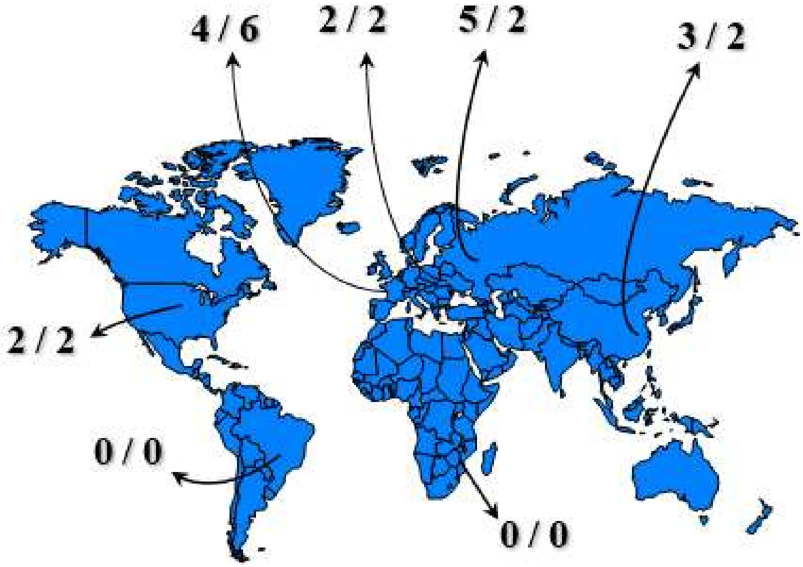
The IAEA officers responsible for this publication were R. Cavellec and J. Sugahara of the Division of Nuclear Installation Safety.

CONTENTS

BACKGROUND

Many of the challenges faced by those responsible for ensuring the safe operation of NPPs are common throughout the world. The results of an OSART Mission are, therefore, of interest and possible application to many NPPs and not solely to the plant in which they were originally identified. The primary objective of this report is to enable organizations that are constructing, commissioning, operating or regulating NPPs to benefit from experience gained during missions conducted under the OSART programme during the period 2016-2018.

In 1983, the IAEA set up the Operational Safety Review Team (OSART) programme to assist its Member States in the enhancement of safe operation of NPPs. The service is available to all countries with NPPs under construction, commissioning or in operation upon a request made to the IAEA by its Member States. In February 2018, the OSART programme reached the milestone of the 200^{th} mission at Almaraz NPP, and by the end of 2018, 204 OSART missions had been conducted at 116 NPPs in 36 countries. In addition, 141 follow-up visits had been conducted since 1989, when such visits became a standard feature of the OSART programme. Sixteen (16) OSART missions (including 1 corporate) and fourteen (14) follow-up visits were conducted during the period 2016-2018.



16 OSART Missions / 14 follow-up visits between 2016 and 2018:

Western Europe	4 / 6
Central Europe	2 / 2
Eastern Europe	5 / 2
Asia	3 / 2
North America	2 / 2
South America	0 / 0
Africa	0 / 0

OSART teams consist of senior expert reviewers from NPPs, technical support organizations and regulatory authorities in the various disciplines relevant to the mission. During technical discussions between reviewers and plant staff, operational safety programmes are examined in detail and their performance checked; strengths are identified as good practices. Where issues are identified, the OSART team makes recommendations or suggestions. The criteria used by the teams as they formulate their conclusions are based on IAEA Safety Standards and the best prevailing international practices which may be more stringent than national requirements.

OSART reviews are neither regulatory inspections nor design reviews. Rather, they consider the effectiveness of operational safety programmes and are more oriented to programme, process and management issues than to hardware. The performance or outcome of the various programmes is given particular attention. OSART teams neither assess the adequacy of plant design nor compare or rank the safety performance of different plants.

The OSART Missions consist of three basic types: missions to operating power reactors (OSART); missions to power reactors under construction or at the pre-commissioning stage (Pre-OSART); and Expert missions which cover a limited range of topics or which differ in character from review missions.

The results of OSART Missions completed up to the end of 2015 have been summarized in:

- OSART Results, IAEA-TECDOC-458,
- OSART Results II, IAEA-TECDOC-497,
- OSART Mission Highlights, 1988–1989. IAEA-TECDOC-570,
- OSART Good Practices, 1986-1989, IAEA-TECDOC-605,
- OSART Mission Highlights, 1989-1990, IAEA-TECDOC-681,
- Pre-OSART Mission Highlights, 1988-1990. IAEA-TECDOC-763,
- OSART Mission Highlights 1991-1992, IAEA-TECDOC-797,
- OSART Programme Highlights 1993-1994, IAEA-TECDOC-874,
- OSART Programme Highlights 1995-1996, IAEA-TECDOC-1018,
- OSART Mission Highlights 2001-2003, IAEA-TECDOC-1446,
- OSART Mission Highlights 2003-2006,
- OSART Mission Highlights 2007-2009,
- OSART Mission Highlights 2010-2012,
- OSART Mission Highlights 2013-2015.

Since 1996, the results of OSART Missions have been made available to Member States on the OSART Mission Results Database (OSMIR).

Following the latest OSART Guidelines revised in February 2016, Ref. IAEA Services Series number 12 (Rev.1), OSART Missions normally cover eleven areas for an operational plant, namely: Leadership and Management for Safety (LMS), Training and Qualification (TQ), Operations (OPS), Maintenance (MA), Technical Support (TS), Operating Experience Feedback (OEF), Radiation Protection (RP), Chemistry (CH), Emergency Preparedness and Response (EPR), Accident Management (AM) and Human-Technology-Organization interaction (HTO). Among these, AM and HTO were introduced as a standard area after the Fukushima Daiichi accident. In addition, to these review areas, four review areas can be applied to OSART Missions depending on the needs of Member States: Long term operation (LTO) for NPPs planning to extend their operating lifetime, Commissioning (COM) if the review is carried out close to the time of commissioning, Transitional period from operation to decommissioning (TRAD) for NPPs with a near term scheduled final shutdown date and use of PSA for plant operational safety improvements (PSA) for plants asking more detailed review on the application of probabilistic safety analysis. In the case where NPPs need a full assessment of the safety culture and a methodology applying a broader use of them, Independent Safety Culture Assessment (ISCA) can also be conducted as a complementary module.

Over the thirty years of experience with the OSART programme, significant changes have taken place in the OSART methodology, nuclear industry transparency and operational safety practices at nuclear power plants. In this period, the guidelines and experience of OSART team members have also evolved to reflect the higher standards for operational safety practices now being adopted worldwide.

The terms 'recommendation', 'suggestion' and 'good practice' are defined as follows in the framework of OSART reviews:

Recommendation

A recommendation is advice on what improvements in operational safety should be made in that activity or programme that has been evaluated. It is based on inadequate conformance with the IAEA Safety Requirements and addresses the general concern rather than the symptoms of the identified concern. Recommendations are specific, realistic and designed to result in tangible improvements.

Suggestion

A suggestion is advice on an opportunity for safety improvement not directly related to inadequate conformance with the IAEA Safety Requirements. It is primarily intended to make performance more effective, to indicate useful expansions to existing programmes and to point out possible superior alternatives to ongoing work.

Good practice

A good practice is an outstanding and proven programme, activity or equipment in use that contributes directly or indirectly to operational safety and sustained good performance. A good practice is markedly superior to that observed elsewhere, not just the fulfilment of current requirements or expectations. It should be superior enough and have broad enough application to be brought to the attention of other nuclear power plants and be worthy of their consideration in the general drive for excellence. A good practice is novel; has a proven benefit; is replicable (it can be used at other plants); and does not contradict an issue. Normally, good practices are brought to the attention of the team on the initiative of the plant.

An OSART mission is requested by Member States in a letter submitted to the IAEA Deputy Director General, Nuclear Safety and Security Department, 18-24 months before its proposed date.

Information regarding OSART can be accessed on the IAEA OSART website (https://www.iaea.org/services/review-missions/operational-safety-review-team-osart) or by an e-mail request to OSS Contact Point (Operational-Safety.Contact-Point@iaea.org).

1. INTRODUCTION AND MAIN CONCLUSIONS

1.1. Summary

During the period 2016-2018, 16 OSART Missions, listed below, reviewed plants around the world. As a result, this report contains the accumulated findings (recommendations, suggestions and good practices) that present a series of snapshots of the status of operational safety practices at these NPPs.

Plant	Country	Year
Pickering	Canada	2016
Golfech	France	
Cernavoda	Romania	
Taishan	China	2017
Olkiluoto 1 & 2	Finland	
Krsko	Slovenia	
Sequoyah	USA	
Barakah	UAE	
Bugey	France	
Leningrad	Russian Federation	
Torness	UK	2018
Almaraz 2	Spain	
Olkiluoto 3	Finland	
Loviisa	Finland	
Bushehr	Iran	
REA corporate	Russian Federation	

The IAEA evaluated the common findings and achievements derived from these OSART Missions and these are presented in this report.

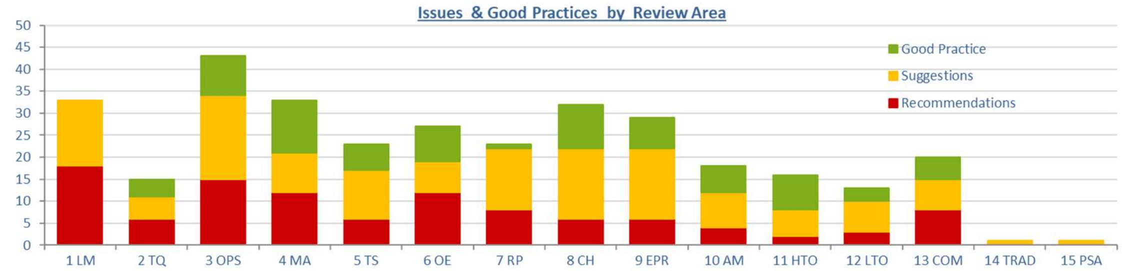
The lower number of issues observed during the missions reflects an increased level of application of the IAEA Safety Standards by almost all the plants reviewed. Meanwhile, the high number of good practices recorded shows a high level of implementation of the best international practices in the industry. In this sense, plant managements and staff show that they clearly understand the importance of nuclear safety.

At many plants, the OSART teams were impressed by the level of preparation for the review, the openness of the counterpart teams and their readiness to cooperate.

While the nuclear industry has made significant advances in safety, there is always room for further improvement: OSART teams have identified many operational safety aspects where improvements can be made. At the same time, the assessment teams and plants reviewed have provided the IAEA with valuable feedback that allows continuous improvement of the IAEA services aimed at operational safety review and enhancement.

The table below shows the number of issues resulting in either Recommendations or Suggestions (248) and the number of Good Practices (82) identified to the plants during the 16 OSART Missions between 2016 and 2018. All these findings form the basis of the evaluation proposed in this report:

OSART Mission results:



	LM	TQ	OPS	MA	TS	OE	RP	CH	EPR	AM	HTO	LTO	COM	TRAD	PSA	Total
Issues	**33**	**11**	**34**	**21**	**17**	**19**	**22**	**22**	**22**	**12**	**8**	**10**	**15**	**1**	**1**	**248**
(Rec.)	18	6	15	12	6	12	8	6	6	4	2	3	8	0	0	106
(Sug.)	15	5	19	9	11	7	14	16	16	8	6	7	7	1	1	142
Good Practices	**4**	**9**	**12**	**6**	**8**	**1**	**10**	**7**	**6**	**8**	**3**	**5**	**0**	**0**	**3**	**82**
Applied Missions	15	15	15	15	15	15	15	15	14	15	11	8	3	1	2	-

Corporate OSART Mission results:

	CM	IO	CS	COM	MA	TS	OE	PR	EPR/AM	Total
Issues	**1**	**1**	**0**	**0**	**1**	**0**	**1**	**1**	**1**	**6**
(Rec.)	0	0	0	0	0	0	0	0	1	1
(Sug.)	1	1	0	0	1	0	1	1	0	5
Good Practices	**0**	**0**	**0**	**2**	**0**	**0**	**1**	**0**	**0**	**3**
Applied Missions	1	1	1	1	1	1	1	1	1	-

The main task of the OSART Highlights assessment team formed by the IAEA was to evaluate the mission results and weight the findings. To do this, the team decided to use the following statements:

– ‘In many plants’ or ‘frequently’ is used for a number of issue items found in about 8 to 15 plants out of 15 missions (more than 50% of the cases). (EPR; 7 to 14, LTO; 5 to 8, COM; 2 to 3);

– ‘In some plants’ reflects that in 4 to 7 plants out of 15 missions, the OSART teams found the same issue topic (from 20% to 50% of the cases). (EPR; 3 to 6, LTO; 3 to 4);

– ‘In a few plants’ means that the frequency of finding or the equivalent sort of issues appears in 2 to 3 plants against 15 missions (up to 20% of the cases). (EPR; 2, LTO; 2).

The tendencies which are obtained from the assessment of Issues and Good Practices of 15 OSART Missions are arranged to ‘Common findings’ for each review area. Corporate OSART Mission results are not evaluated in depth because only one Corporate OSART mission was conducted.

1.2. Summary of common findings classified by area

• Leadership and Management for Safety

- In many plants, industrial safety hazards/risks are not always identified, addressed and minimized. (8/15)
- In some plants, plant management expectations are not consistently set, fully communicated, implemented nor systematically reinforced and challenged in the field by the plant leadership. (7/15)
- In a few plants, the fitness for duty programme is not implemented or some gaps exist. (3/15)
- In a few plants, the plant’s performance indicators are not fully utilized to detect and react to adverse trends in the safety performance. (3/15)
- In a few plants, management does not encourage the staff to report deficiencies and correct unsafe behaviours. (3/15, including 1 issue from OPS)

• Training and Qualifications

- In some plants, a Systematic Approach to Training (SAT) is not fully developed and implemented. (6/15)
- In some plants, deficiencies in training environment and behaviours during simulator training are not consistently corrected. (4/15, including 1 issue from OPS)

• Operations

- In some plants, human performance tools are not consistently used and error likely situations are not minimized. (5/15)
- In some plants, operating documentation is not strictly controlled, timely reviewed and revised. (4/15)
- In some plants, equipment defects are not identified and reported. (4/15)
- In some plants, equipment labelling and housekeeping are not consistently maintained. (4/15)
- In some plants, storage and inventory control of the combustible materials is not conservative enough in minimizing fire loads. (4/15)
- In a few plants, conduct of operations in the Main Control Room is not performed in an attentive and controlled manner. (3/15)
- In a few plants, computerized and software tools are used for fire protection status control, emergency response and training of personnel. (Good practices; 3/15)

- In a few plants, reliability and integrity of fire barriers/zones is not adequately ensured. (2/15)
- In a few plants, arrangements for hot works are not strictly followed. (2/15)

• Maintenance

- In some plants, maintenance tools and equipment, storage areas and workplaces are not properly controlled and managed to provide for safe and efficient maintenance activities. (6/15)
- In some plants, the control and implementation of maintenance activities are not consistent and effective enough to ensure adequate equipment reliability and availability. (6/15)
- In some plants, the material condition of equipment is inadequate to support safe and reliable operation. (4/15)
- In a few plants, Foreign Material Exclusion (FME) programme is not rigorously applied to prevent foreign material intrusion into systems and components related to safety. (2/15, including 1 issue from OPS)
- In a few plants, spare parts are not always controlled with sufficient attention for their storage condition and availability. (2/15)

• Technical Support

- In some plants, temporary modifications are not adequately controlled to minimize their cumulative effect on plant safety. (5/15)
- In some plants, temporary or movable equipment and items near seismically qualified SSCs are not always identified, properly controlled and restrained to minimize their potential to affect safety related equipment. (4/15)
- In a few plants, the scope of the Periodic Safety Review (PSR) is not comprehensive enough to cover all plant facilities and all safety factors. (2/15)
- In a few plants, permanent modifications are not always properly managed to ensure that they are effectively identified, screened, designed, assessed and implemented. (2/15)

• Operating Experience Feedback

- In some plants, Corrective Actions (CA) are not always adequately defined and implemented in a timely manner to prevent event recurrence. (5/15)
- In some plants, the process for analysis of events does not ensure that events are always investigated with the necessary depth and timeliness. (4/15)
- In a few plants, events are not effectively trended to identify adverse trends in a systematic and consistent manner. (3/15)
- In a few plants, the screening process is not robust enough to ensure that all events are categorized according to their significance. (2/15)

• Radiation Protection

- In some plants, the ALARA programme is not comprehensive enough to drive continuous optimization of radiological work and does not fully address source term reduction to minimize doses to plant staff. (6/15)
- In some plants, the radiation work control practices are not adequate to prevent the spread of contamination. (5/15)
- In a few plants, the barriers, signage and information posted are not sufficient to ensure that workers are aware of radiological conditions. (3/15)
- In a few plants, the staff do not demonstrate the commitment to radiation protection standards and do not have the required knowledge to implement them. (2/15)
- In a few plants, the prevention, tracking and follow up of contamination events are not effective. (2/15)

• Chemistry

- In many plants, the control and storage of chemicals and substances used in the plant are not always effective to preserve the integrity and availability of the plant systems. (8/15)
- In many plants, the chemistry monitoring programme is not sufficiently comprehensive to provide an effective evaluation of plant chemical operational conditions and parameters. (8/15)
- In a few plants, equipment supporting the control of chemistry conditions (such as pumps and tanks) is not always maintained available to prevent the potential of adverse system component corrosion or fouling. (2/15)

• Emergency preparedness and response

- In many plants, the arrangements for the preparedness of emergency facilities and equipment are not always adequate. (8/14)
- In some plants, not all emergency response arrangements described in the emergency plan have been validated during exercises. (4/14)
- In some plants, the drills and exercises programme is not rigorous enough to identify and implement improvement opportunities. (4/14)
- In a few plants, the arrangements during emergency response are not sufficient to ensure the protection of all persons on site. (3/14)

• Accident Management

- In a few plants, the scope of exercises/drills and effectiveness of training programmes are insufficient to ensure adequate level of knowledge and capability to respond to severe accident. (3/15)
- In a few plants, the scope of the severe accident management guidelines is not broad enough to include severe accidents with an open primary system, multi-unit events and accidents involving spent fuel pools. (2/15)

- In a few plants, the arrangements for use of Severe Accident Management Equipment are not sufficient to demonstrate the deployment and capability of the mobile accident management equipment. (2/15)

- **Human-Technology-Organization interaction**

  - In a few plants, continuous improvements are not effectively promoted, pursued and reinforced. (3/11)
  - In a few plants, human performance tools are not comprehensively and consistently applied and reinforced. (2/11)

- **Long Term Operation**

  - In many plants, the LTO scoping and screening is incomplete, not finalized or not well documented to enable scope completeness review and verification. (5/8)
  - In a few plants, the review of ageing management programmes and revalidation of Time Limited Ageing Analysis (TLAAs) for structures and components within the scope for LTO is not completed. (2/8)

- **Commissioning**

  - In all plants, the meeting of commissioning milestones without compromising safety is challenging. (3/3, including 2 issues from OPS)
  - In many plants, the plant personnel do not demonstrate ownership for equipment and staff safety in all areas and phases of commissioning. (2/3)
  - In many plants, equipment is not appropriately protected during commissioning stage. (2/3)
  - In many plants, configuration changes are not properly controlled. (2/3)
  - In many plants experience feedback process does not prevent reoccur of events. (2/3)

- **Transitional period from operation to decommissioning**

  - Not applicable (Reviewed in only one mission)

- **Use of PSA for plant operational safety improvements**

  - No common findings

2. ASSESSMENT OF THE OSART MISSIONS RESULTS AREA BY AREA

The following summarizes the tendencies identified in the findings.

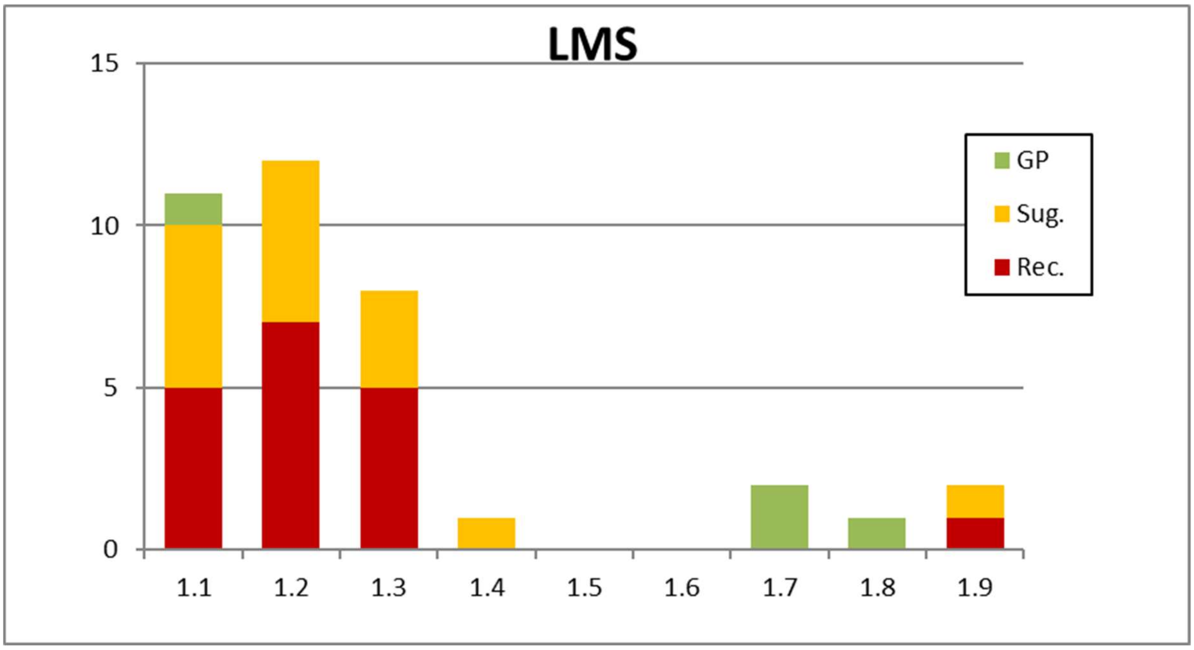
Important common findings are highlighted by an underline; they can be used as stand-alone input to other evaluative documents. Where the facts or findings of the OSART Missions address a common problem, the common finding is complemented by several examples of observation, a discussion on the weight of these findings and possible corrective actions.

2.1. Leadership and Management for Safety

2.1.0. Summary of findings

The review of the LMS area in the 15 visited NPPs resulted in 37 findings from which there are 18 recommendations, 15 suggestions and 4 good practices. The distribution of the findings between the different topics of the LMS review is presented below:

Title		Rec.	Sug.	GP	Total
1.1	Leadership for safety	5	5	1	11
1.2	Integrated management system	7	5	0	12
1.3	Non-radiation-related safety programme	5	3	0	8
1.4	Document and records management	0	1	0	1
1.5	Interfaces and relationships	0	0	0	0
1.6	Graded approach	0	0	0	0
1.7	Human factors management	0	0	2	2
1.8	Continuous improvement/learning organization	0	0	1	1
1.9	Safety culture	1	1	0	2
	Total	18	15	4	37



2.1.1. Leadership for safety

- Findings: 5 recommendations, 5 suggestions, 1 good practice
- Common finding: In some plants, plant management expectations are not consistently set, fully communicated, implemented nor systematically reinforced and challenged in the field by the plant leadership. (7/15)

  Examples show:

  - The plant's management processes, setting of management expectations and supervision of activities are not effective to ensure high safety performance and timely resolution of identified deficiencies.
  - Managers do not effectively reinforce their expectations of plant personnel behaviour and practices, allowing gaps in industrial safety behaviours and gaps in adhering to deadlines and processes.
  - The plant management and staff do not always challenge inappropriate behaviours or provide coaching to ensure that expectations on safety of activities conducted in the field are met.
  - Some managers do not consistently meet the objectives of the field observation and coaching programme.
  - Plant management expectations are not fully communicated, implemented nor systematically reinforced to ensure safety of personnel and equipment.

  SSR-2/2 Rev.1
  4.2. The safety performance standards and the expectations of the management for safety performance shall be clearly communicated to all personnel, and it shall be ensured that they are understood by all those involved in their implementation.

- Other issues are:
  - The plants actions to address the open technical issues might not lead to their timely resolution and adequate margins.
  - The senior management does not always proactively address identified challenges to continuously improve the safety and reliability of the plant.
  - A number of tools and aids to efficiently implement the Integrated Management System are not yet in place.
  - The plant is not fully utilizing and challenging the key performance measures, processes and results in order to ensure sustainability of the many improvement initiatives they have launched.
- The good practice is:
  - A leadership development programme adapted to the multi-cultural, multi-national nature of the organization, to ensure that the cultural diversity is addressed, maintained and leveraged to build strong teams with a focus on safe operation of the plant was established.

2.1.2. Integrated management system

- Findings: 7 recommendations, 5 suggestions, 0 good practices
- Common finding: In a few plants, the fitness for duty programme is not implemented or some gaps exist. (3/15)

Examples show:

- The plant has not implemented a fitness-for-duty programme.
- The plant does not use alcohol or drug tests without cause in its existing fitness for duty program.
- The plant does not sufficiently document the results of the ongoing alcohol and drug tests in its fitness for duty program.

SSR-2/2 Rev.1
4.29. Aspects of the working environment that influence human performance factors (such as workload or fatigue) and the effectiveness and fitness of personnel for duty shall be identified and controlled.

- Common finding: In a few plants, the plant's performance indicators are not fully utilized to detect and react to adverse trends in the safety performance. (3/15)

Examples show:

- The plants internal performance indicators are not fully utilized as a management tool to detect, analyze and correct shortfalls in performance.
- The plant is not fully utilizing leading and challenging performance indicators to ensure that potential declining performance is identified early and ensure the sustainability of current performance improvement.
- The station's action plans, self-assessment programme, performance targets and measures are not always sufficiently challenging or aggressively pursued to improve safety performance.

SSR-2/2 Rev.1
4.34. Where practicable, suitable objective performance indicators shall be developed and used to enable senior managers to detect and to react to shortcomings and deterioration in the management of safety.

- Other issues are:
  - The plant has many processes and systems that show a backlog of issues and the holistic prioritization and planning process for managing the overall plant priorities is not fully effective.
  - Management expectations are not systematically achieved in the preparation or execution of tasks involving the use of procedures.
  - Some important spare parts are not acquired in a timely manner due to the challenges in the overall procurement process to support the reliability and safety of plant systems and equipment.
  - Organizational changes are not sufficiently foreseen, assessed and kept under control at the plant.
  - The plant management oversight of the pre-operational workload is not effective to ensure the needs of the future operating organization for safe operation are met and aligned to plant objectives.

One issue was transferred to 2.1.1. Leadership for Safety since it supported a common finding.

2.1.3. Non-radiation-related safety programme

- Findings: 5 recommendations, 3 suggestions, 0 good practices
- Common finding: In many plants, industrial safety hazards/risks are not always identified, addressed and minimized. (8/15)

  Examples show:

  – Some non-radiation related safety hazards are not identified and addressed in a timely manner and expectations are not consistently reinforced.
  – Industrial safety risks and unsafe behaviours are not minimized on the site.
  – Plant industrial safety measures are not effective enough to keep a low lost time accident rate for contractors.
  – Although standards and expectations for industrial safety are clearly defined and communicated throughout the organization, several facts were observed e.g. insufficient pre-job briefings; not following safety signage by staff; workers without wearing the appropriate PPE; workers in dangerous situations; supervisor did not intervene to stop unsafe behaviours of workers.
  – Industrial safety risks are not always identified and minimized at the plant, e.g. Activities without risk assessment for the work; Unclear signage on industrial safety requirements.

  SSR-2/2 Rev.1
  Requirement 23: The operating organization shall establish and implement a programme to ensure that safety related risks associated with non-radiation-related hazards to personnel involved in activities at the plant are kept as low as reasonably achievable.

2.1.4. Document and records management

- Finding: 0 recommendations, 1 suggestion, 0 good practices
- No common finding
- The issue is:

  – Shortfalls in the use of written procedures, procedure adherence and adherence to review, revision and validation process do not ensure adequate response during emergency conditions, operation and testing of plant equipment important to plant safety.

2.1.5. Interfaces and relationships

- No Finding

2.1.6. Graded approach

- No Finding

2.1.7. Human factors management

- Findings: 0 recommendations, 0 suggestions, 2 good practices
- No common finding

- Good practices are:
  - Implementation of specialized rooms for psychological and physiological support to improve individual performance reliability.
  - Analysis of physiological value of plant main control room operators.

2.1.8. Continuous improvement/learning organization

- Finding: 0 recommendations, 0 suggestions, 1 good practice
- No common finding
- The good practice is:
  - Nuclear Safety Culture assessments within the supplier organization during construction and commissioning.

2.1.9. Safety culture

- Findings: 1 recommendation, 1 suggestion, 0 good practices
- <u>Common finding: In a few plants, management does not encourage the staff to report deficiencies and correct unsafe behaviours. (3/15, including 1 issue from paragraph 2.3.4. in OPS)</u>

  Examples show:
  - The plant's standards and practices for reporting and correcting minor deficiencies in the general material condition of equipment are not consistently implemented by workers, supervisors and management.
  - Plant personnel are not always challenging and correcting unsafe behaviours and physical conditions in a timely manner to ensure personnel and plant safety.
  - The supervision of field operations is not always effective in ensuring that minor plant deficiencies are identified and reported.

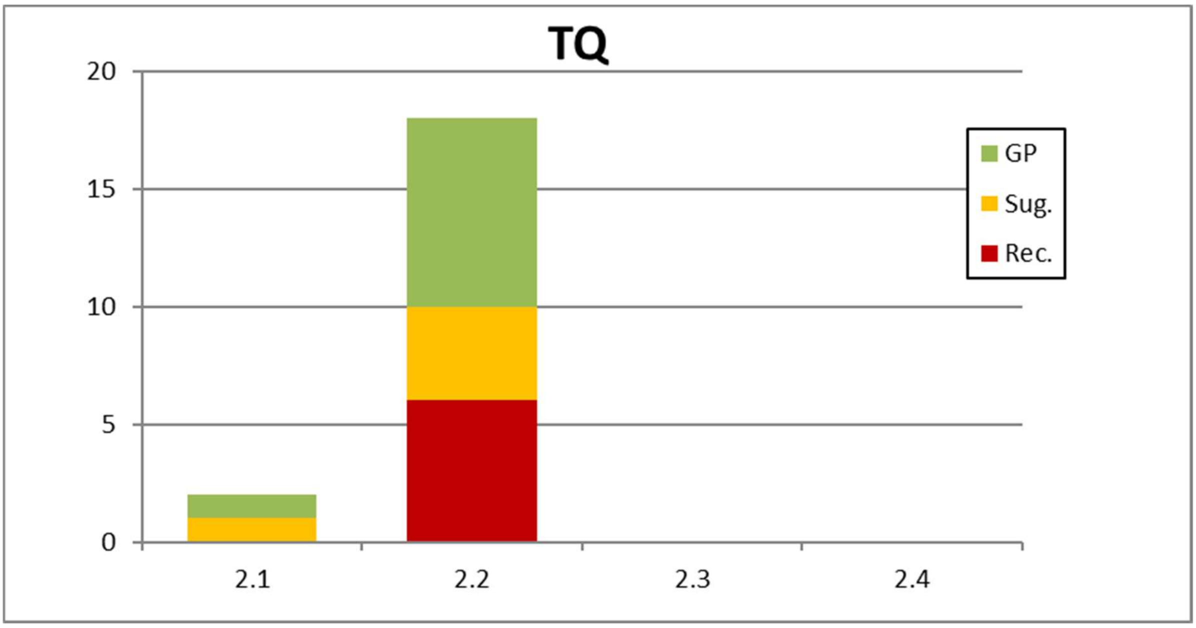
  SSR-2/2 Rev.1
  4.30. The operating organization shall encourage plant personnel to have a questioning attitude and to make appropriate and conservative decisions, so as to minimize risk and to maintain the plant in a safe condition.

2.2. Training and qualification

2.2.0. Summary of findings

The review of the TQ area in the 15 visited NPPs resulted in 20 findings from which there are 6 recommendations, 5 suggestions and 9 good practices. The distribution of the findings between the different topics of the TQ review is presented below:

	Title	Rec.	Sug.	GP	Total
2.1	Organization and functions	0	1	1	2
2.2	Qualification and training of personnel	6	4	8	18
2.3	Records and reports	0	0	0	0
2.4	Use of PSA and PSR	0	0	0	0
	Total	6	5	9	20



2.2.1. Organization and functions

- Findings: 0 recommendations, 1 suggestion, 1 good practice
- No common finding
- The issue is:
  - Standards in the training environment (including signage labelling, use of human performance tools and housekeeping) do not always match those expected in the plant.
- The good practice is:
  - An Accreditation Manual defines the general criteria for initial training, qualification and continuous training requirements as a means of guaranteeing that appropriate and necessary competency levels for each position are obtained and maintained.

2.2.2. Qualification and training of personnel

- Findings: 6 recommendations, 4 suggestions, 8 good practices

- Common findingCommon finding: in some plants, a Systematic Approach to Training (SAT) is not fully developed and implemented. (6/15)

  Examples show:

  - In terms of analysis of needs:
    - Competence and qualification requirements are not defined for all relevant staff.
    - Knowledge, skills and attitudes analysis is not completed, and job descriptions are not enough detailed.
    - There is little involvement of line managers in the training process.
    - The need for requalification or refresher training is not always defined.
    - Requirements for recruitment of instructors are not defined.
  - In terms of training design and development:
    - Some trainings are not associated with training objectives, training setting and duration.
    - Training materials are too generic, are not updated on a regular basis, there is sometimes no training materials and new personnel are just asked to read relevant procedures.
    - On-the-Job Training (OJT) is not linked to competences needs and guidelines for OJT are not fully developed.
  - In terms of implementation:
    - SAT process is only implemented in some departments.
    - Training content is not matching training objectives.
    - Required trainings are not always completed by all the targeted audiences.
  - In terms of evaluation:
    - Some trainings have no formal assessment or are only partially evaluated.
    - Observation of training activities by managers and supervisors are not performed.
    - The set of training performance indicators is not comprehensive enough.

  SSR-2/2 Rev.1
  Requirement 7: The operating organization shall ensure that all activities that may affect safety are performed by suitably qualified and competent persons.
  4.20. […] The content of each programme shall be based on a systematic approach. […]

- Common finding: In some plants, deficiencies in training environment and behaviours during simulator training are not consistently corrected. (4/15, including 1 issue from paragraph 2.3.4 in OPS)

  Examples show:

  - Shortfalls in shift crew performance during simulator continuing training are not consistently corrected. This includes deficiencies in alarm response management and incomplete monitoring of safety-related control room parameters.
  - Arrangements for timely update and modification of the full scope simulator environment do not ensure that it reflects current plant conditions, operating policies and procedures.

  SSR-2/2 Rev.1
  4.20 […] Training programmes shall promote attitudes that help to ensure that safety issues receive the attention that they warrant.

4.21 […] A system shall be put in place for the timely modification and updating of the training facilities, computer models, simulators and materials to ensure that they adequately reflect current plant conditions and operating policy, and that any differences are justified.

- The other issue is:
  - Lack of sufficient time assigned to instructors for field activities to maintain their technical knowledge, skills and familiarity of work practices.

- Good practices are:
  - A clear and informative training package for newcomers called "Outage for Dummies".
  - Main Control Room (MCR) simulators features and training interface for monitoring and tracking of main control room crew performance.
  - Collaboration between the plant and the national authority to develop the qualification for nuclear positions to take credit for prior learning and qualification and shortening the time necessary for training of plant employees.
  - The use of a mock-up in support of improved fuel route training.
  - Use of knowledge sharing multidisciplinary groups of technical staff that can support each other on particular systems.
  - Use of medical and psychological fitness for duty examinations in recruitment and selection.

2.2.3. Records and reports

- No finding

2.2.4. Use of PSA and PSR

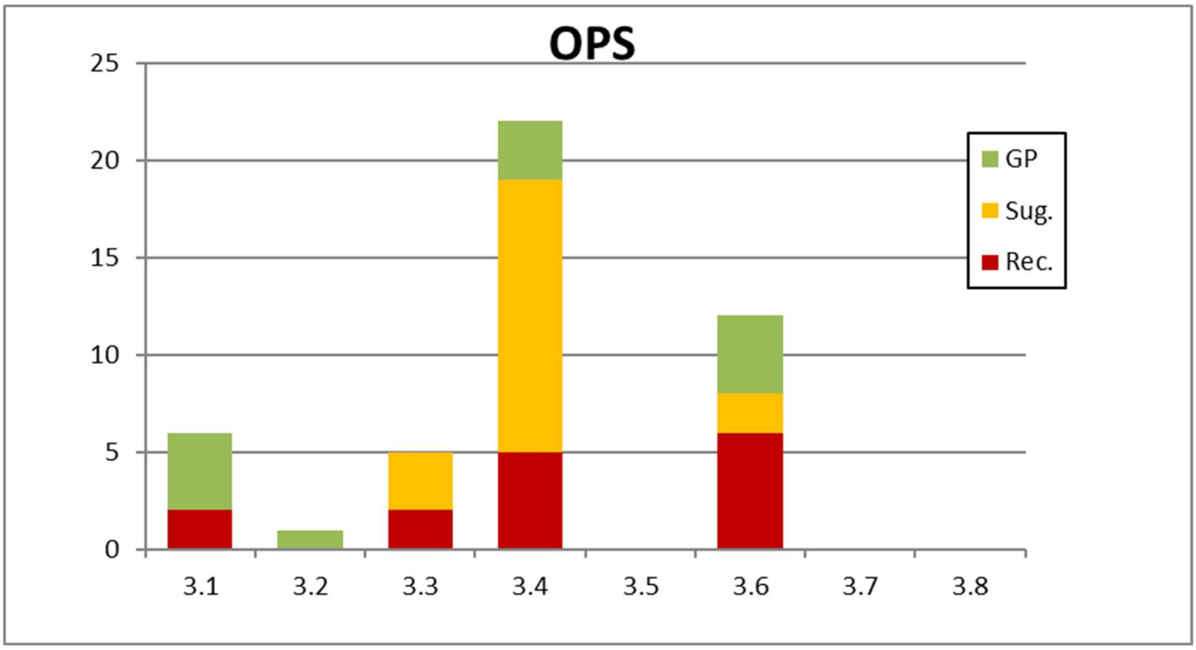
- No finding

2.3. Operations

2.3.0. Summary of findings

The review of the OPS area in the 15 visited NPPs resulted in 46 findings from which there are 15 recommendations, 19 suggestions and 12 good practices. The distribution of the findings between the different topics of the OPS review is presented below:

Title		Rec.	Sug.	GP	Total
3.1	Organization and functions	2	0	4	6
3.2	Operations equipment	0	0	1	1
3.3	Operating rules and procedures	2	3	0	5
3.4	Conduct of operations	5	14	3	22
3.5	Work control	0	0	0	0
3.6	Fire prevention and protection programme	6	2	4	12
3.7	Control of plant configuration	0	0	0	0
3.8	Use of PSA and PSR	0	0	0	0
	Total	15	19	12	46



2.3.1. Organization and functions

- Findings: 2 recommendations, 0 suggestions, 4 good practices
- No common finding
- One issue is supporting the common finding in Commissioning area, paragraph_2.13.2.:
  - The plant provisions and practices for the practical preparedness of field operators to operate plant specific systems and equipment are not adequate and effective to ensure their sufficient competence required for the first core load.
- The other issue is:
  - Some operational practices are not prioritized, implemented and monitored to ensure safe operation of the plant.

- Good practices are:
  - A live computer program to maintain minimum complement of qualified staff which must be on site at all times to ensure the safe operation of the facility.
  - A visual system for identifying all valves that are used when applying emergency operating procedures, in the form of fluorescent tags.
  - The plant implements a programme to develop leadership for safety awareness, behaviour and skills of their Shift Supervisors.
  - Succession planning on operations using spider diagrams.

2.3.2. Operations equipment

- Finding: 0 recommendations, 0 suggestions, 1 good practice
- No common finding
- The good practice is:
  - Electronic plant drawings system which is available to Main Control Room and field operators.

2.3.3. Operating rules and procedures

- Findings: 2 recommendations, 3 suggestions, 0 good practices
- <u>Common finding: In some plants, operating documentation is not strictly controlled, timely reviewed and revised. (4/15)</u>

  Examples show:
  - Operating procedures are not always prepared, revised and issued in a manner that supports effective control of plant systems, equipment, and components:
    - In one plant a significant part (about 30%) of operating procedures exceeded its periodic review time limit,
    - Some of permanent or long-standing temporary modifications are not properly reflected in operating procedures,
    - Sometimes required temporary operating procedures are not issued. In other cases, such safety related temporary procedure are not incorporated into main operating procedure although the modification was in place for 8 years.
  - The quality of operating procedures could be improved. Operating procedures have inaccuracies or do not contain some needed steps, important information or references as it is required.
  - The control of operator aids is not always adequate. Uncontrolled or outdated operator aids are in use.

  SSR-2/2 Rev.1
  7.1. The level of detail for a particular procedure shall be appropriate for the purpose of that procedure. The guidance provided in the procedures shall be clear and concise and, to the extent possible, it shall be verified and validated.

  7.4. Operating procedures and supporting documentation shall be issued under controlled conditions, and shall be subject to approval and periodically reviewed and revised as necessary to ensure their adequacy and effectiveness. Procedures shall be updated in a timely manner in the light of operating experience and the actual plant configuration.

7.5. […] The control system for operator aids shall be used to ensure that operator aids contain correct information and that they are updated, periodically reviewed and approved.

- One issue is supporting the common finding in Commissioning area, paragraph 2.13.2.:
  - Main Control Room document availability does not fully support the anticipated fuel load and operating programme.

2.3.4. Conduct of operations

- Findings: 5 recommendations, 14 suggestions, 3 good practices
- Common finding: In some plants, human performance tools are not consistently used and likely error situations are not minimized. (5/15)

  A similar common finding is identified in paragraph 2.11.2. HTO area.

  Examples show:

  - The human performance tools are not always effectively applied and reinforced:
    - Clear expectations on use of human error prevention tools are not set,
    - The pre-job briefings in some cases are performed informally and their scope is insufficient,
    - The use of self-check tool is not always evident,
    - Three-way and clear communications are performed with deviations,
    - Peer check is not always provided when required by the plant expectations.
  - The protection of in-service and available safety-related equipment is not consistently applied to avoid human errors.

SSR-2/2 Rev.1
4.29. Aspects of the working environment that influence human performance factors (such as workload or fatigue) and the effectiveness and fitness of personnel for duty shall be identified and controlled. Tools for enhancing human performance shall be used as appropriate to support the responses of operating personnel.

NS-G-2.14
4.27. Pre-job briefings should be used as a means of avoiding personnel errors, difficulties in communication and misunderstandings. The operations shift crew should use pre-job briefings for all operations other than daily, routine shift activities. […]

4.44. All verbal communications within the shift or between the shift crew and other groups should be clear and concise and the communication process should cover both the provision and the receipt of correct information. […]

5.12. […] Before initiating the tagging process for trains or components, the shift supervisor should conduct a pre-job briefing, which should also cover the status of the plant and nonrelated components or trains. Additionally, procedures should be established to provide for warning barriers and signs located in the plant close to such redundant systems to alert operators and workers to their special protected status.

- Common finding: In some plants, equipment defects are not identified and reported. (4/15)

  Examples show:

  - Deficiencies are not always identified and reported:
    - Field operators do not effectively identify defects during the field round,
    - Multiple cases of oil, steam and water leaks, defects of electrical and I&C equipment are not identified and reported,
    - Multiple instances of corrosion are not identified and reported,
    - Defects of insulation are not identified and reported,
    - In some areas the lighting is absent or insufficient.
  - Defects do not have tags for clear identification in the field.

  SSR-2/2 Rev.1
  7.10. Administrative controls shall be established to ensure that operational premises and equipment are maintained, well lit and accessible, and that temporary storage is controlled and limited. Equipment that is degraded (owing to leaks, corrosion spots, loose parts or damaged thermal insulation, for example) shall be identified and reported and deficiencies shall be corrected in a timely manner.

- Common finding: In some plants, equipment labelling and housekeeping are not consistently maintained. (4/15)

  Examples show:

  - Plant identification and labelling is inconsistent in its format and content.
  - The plant expectation for equipment labelling is not consistently maintained to provide clear identification of equipment:
    - Handwritten, damaged or difficult to read equipment labels are in use,
    - Equipment noted with missing labels.
  - The plant housekeeping program is not always effective:
    - Different items such as tools, used personal protective equipment, debris, loose materials are laying on the floor,
    - Unauthorized and not meeting standards laydown areas are in place,
    - Industrial safety hazards (such as tripping hazards) are not identified and reported.

  SSR-2/2 Rev.1
  7.12. The operating organization shall be responsible for ensuring that the identification and labelling of safety equipment and safety related equipment, rooms, piping and instruments are accurate, legible and well maintained, and that they do not introduce any degradation.

  NS-G-2.14
  6.20. Plant housekeeping should maintain good conditions for operation in all working areas. Working areas should be kept up to standard, well lit, clean of lubricants, chemicals or other leakage and free of debris; the intrusion of foreign objects should be prevented and an environment should be created in which all deviations from normal conditions are easily identifiable (such as small leaks, corrosion spots, loose parts, unauthorized temporary modifications and damaged insulation). […]

- Common finding: In a few plants, conduct of operations in the Main Control Room is not performed in an attentive and controlled manner. (3/15)

  Examples show:

  – Plant expectations with respect to behaviours related to the Main Control Room (MCR) are not adequately developed or reinforced to minimize distractions and promote error-free operation:
    – Arrangements for alarm response in MCR are not established,
    – Conditions in MCR during shift turnover, pre-job briefings and routine operations do not exclude the distraction of MCR staff.

  – Operators performance and behaviours for some MCR activities do not always ensure high standards. MCR personnel do not timely react to raising alarms and announce them for other MCR crew members.

  NS-G-2.14
  4.3. The management should ensure that distractions to the shift personnel are minimized to enable the crew to remain alert to any changes in plant conditions.

  4.31. Operators in the control room should maintain serious and attentive behaviour at all times. Operators should adhere strictly to plant policies with regard to the use of procedures, communication protocols, response to alarms and the use of methods in place to prevent or minimize human error. […]

- The issue which supports the common finding in TQ area, paragraph 2.2.2. is:

  – The plant´s arrangements for reactivity manipulations during transients in the Main Control Room, demonstrated during simulated scenarios, do not consistently ensure they are conducted in a deliberate and carefully controlled manner.

- The issue which supports the common finding on MA area, paragraph 2.4.6. is:

  – Fuel route activities do not always ensure rigorous application of the foreign materials exclusion program to prevent the intrusion of foreign materials into station systems and components.

- The issue which supports the common finding on LMS area, paragraph 2.1.9. is:

  – The supervision of field operations is not always effective in ensuring that minor plant deficiencies are identified and reported.

- Good practices are:

  – Plant panoramic tour created using photos of technological areas.

  – Marine Ingress Weather Alert System.

  – Sophisticated key cabinets control system.

2.3.5. Work control

- No finding

2.3.6. Fire prevention and protection programme

- Findings: 6 recommendations, 2 suggestions, 4 good practices
- Common finding: In some plants, storage and inventory control of the combustible materials is not conservative enough in minimising fire loads. (4/15)

  Examples show:

  - The station processes for the control of combustible materials are not fully implemented in the field to minimize fire burden and associated fire risk:
    - The guidance to evaluate fire loads prior to approval of storage of materials or risk assessment of fire loads are not in place or do not meet IAEA standards,
    - Combustible materials are stored without authorization,
    - Field operators are not expected to, and do not demonstrate control of laydown areas during rounds.
  - The plant does not have appropriate arrangements to ensure that fire safety risk due to oil leaks on equipment important for safety and the inventory of accumulated oil is minimized.

  SSR-2/2 Rev.1
  5.21. The arrangements for ensuring fire safety made by the operating organization shall cover the following: adequate management for fire safety; preventing fires from starting; detecting and extinguishing quickly any fires that do start; preventing the spread of those fires that have not been extinguished; and providing protection from fire for structures, systems and components that are necessary to shut down the plant safely. Such arrangements shall include, but are not limited to: […]
  (b) Control of combustible materials and ignition sources, in particular during outages; […]

- Common finding: In a few plants, reliability and integrity of fire barriers/zones is not adequately ensured. (2/15)

  Examples show:

  - Arrangements between construction, commissioning and operations groups are not established to evaluate, control and minimise the cumulative impact of fire hazards:
    - There are no limits on the number of permits which may be in force at any one time and so the accumulated fire loading and status of fire doors within a building is not evaluated or controlled,
    - There are no routine arrangements which are dedicated solely to fire protection and which bring together construction, commissioning and operations teams to evaluate the cumulative defence in depth of fire protection.
  - Measures for fire prevention and mitigation are not always fully implemented:
    - Fire doors are damaged or open,
    - Fire barrier protection in holes/penetrations is incomplete or open,
    - The plant personnel pass through open fire doors without closing them.

  SSR-2/2 Rev.1
  5.21. The arrangements for ensuring fire safety made by the operating organization shall cover the following: adequate management for fire safety; preventing fires from starting; detecting and extinguishing quickly any fires that do start; preventing the spread of those fires that have not been extinguished; and providing protection from fire for structures,

systems and components that are necessary to shut down the plant safely. Such arrangements shall include, but are not limited to: […]
(c) Inspection, maintenance and testing of fire protection measures; […]

- Common finding: In a few plants, arrangements for hot works are not strictly followed. (2/15)

  Examples show:

  – Hot works are organized or performed with deviations from plant expectations. Main Control Room personnel are not always aware of currently performed hot works.
  – The number of walk downs, related to the hot work location after work has been completed, does not meet the plant expectations.

  NS-G-2.1
  6.10. Administrative procedures should be established and implemented to control maintenance and modification activities that necessitate the use of a potential ignition source or that may themselves create an ignition source. […] In the permit system adopted, procedures should be established to cover management, supervision, authorization and performance of the work, inspection of the work area, assignment of fire watch (if stipulated) and access for firefighting. […]

- Good Practice Common finding: In a few plants, computerized and software tools are used for fire protection status control, emergency response and training of personnel. (3/15)

  Examples show:

  – Emergency response software that maps the site in detail and shows graphic information about the real-time tactical situation.
  – A computerized Fire System Program that allows a level by level view of the current status of Fire Protection on all areas of site.
  – Automatic Fire Protection System simulator.

- The other good practice is:
  – Limited authorization time of hot work permits.

2.3.7. Control of plant configuration

- No finding

2.3.8. Use of PSA and PSR

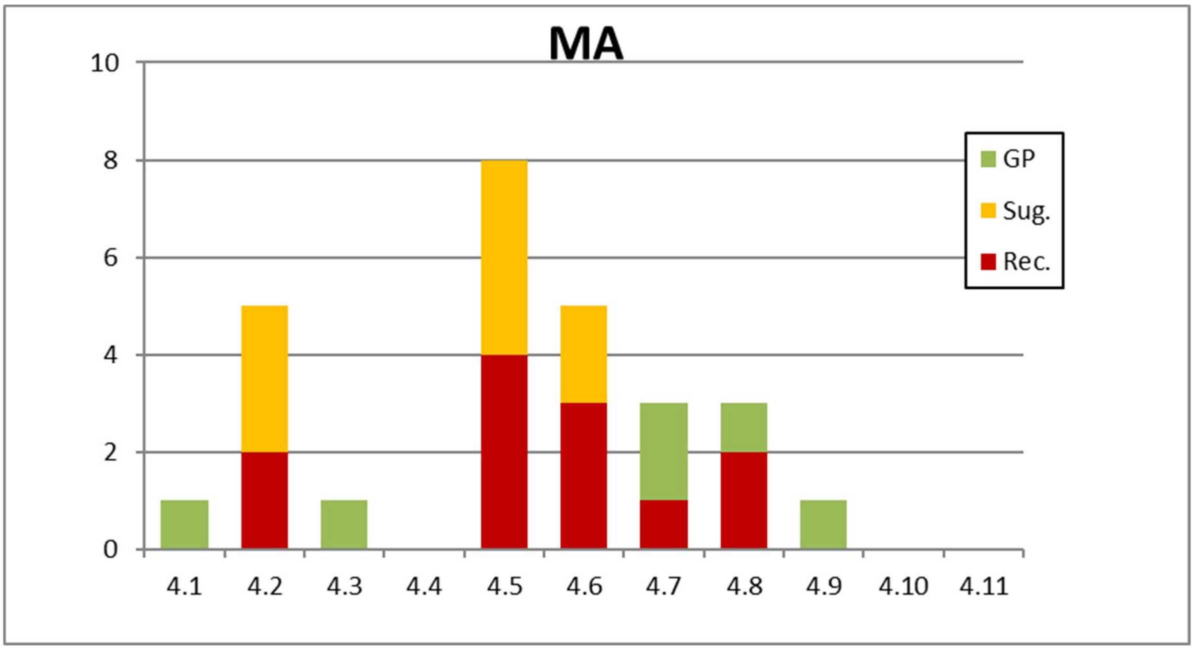
- No finding

2.4. Maintenance

2.4.0. Summary of findings

The review of the MA area in the 15 visited NPPs resulted in 27 findings from which there are 12 recommendations, 9 suggestions and 6 good practices. The distribution of the findings between the different topics of the MA review is presented below:

Title		Rec.	Sug.	GP	Total
4.1	Organization and functions	0	0	1	1
4.2	Maintenance facilities and equipment	2	3	0	5
4.3	Maintenance programmes	0	0	1	1
4.4	Procedures, records and maintenance history	0	0	0	0
4.5	Conduct of maintenance work	4	4	0	8
4.6	Material condition	3	2	0	5
4.7	Work control	1	0	2	3
4.8	Spare parts and materials	2	0	1	3
4.9	Outage management	0	0	1	1
4.10	Configuration control	0	0	0	0
4.11	Use of PSA, PSR and OEF	0	0	0	0
	Total	12	9	6	27



2.4.1. Organization and functions

- Finding: 0 recommendations, 0 suggestions, 1 good practice
- No common finding
- The good practice is:
  - The use of Maintenance Key Performance Indicator (KPI) monitoring tool that allows for maintenance managers and supervisors to monitor and analyze the performance of the department or team against the maintenance KPIs.

2.4.2. Maintenance facilities and equipment

- Findings: 2 recommendations, 3 suggestions, 0 good practices
- Common finding: In some plants, maintenance tools and equipment, storage areas and workplaces are not properly controlled and managed to provide for safe and efficient maintenance activities. (6/15, including 1 issue from paragraph 2.4.5.)

Examples show:

- Several examples of slings, measurement equipment and tools found without inspection tags or calibration labels.
- Several examples of equipment and tools that were not timely inspected or properly managed.
- Several examples of maintenance tools, items and spare parts left abandoned without any identifying information.
- Calibrated and non-calibrated measurement and test equipment are stored without segregation.
- Materials are not always stored in proper conditions.

SSR-2/2 Rev.1
7.10. Administrative controls shall be established to ensure that operational premises and equipment are maintained, well lit and accessible, and that temporary storage is controlled and limited. […]

8.15. The operating organization shall establish suitable arrangements to procure, receive, control, store and issue materials (including supplies), spare parts and components.

8.17. The operation organisation shall ensure that storage conditions are adequate and that materials (including suppliers), spare parts and components are available and are in proper condition for used.

2.4.3. Maintenance programmes

- Finding: 0 recommendations, 0 suggestions, 1 good practice
- No common finding
- The good practice is:
  - The use of a Preventive Maintenance (PM) Feedback System that automatically sends update emails to the originator of the Condition Report (CR) or Work Order (WO) let them know when their concern or input has been addressed.

2.4.4. Procedures, records and maintenance history

- No finding

2.4.5. Conduct of maintenance work

- Findings: 4 recommendations, 4 suggestions, 0 good practices
- Common finding: In some plants, the control and implementation of maintenance activities are not consistent and effective enough to ensure adequate equipment reliability and availability. (6/15)

Examples show:

- Maintenance expectations and work practices are not always adequate to ensure equipment reliability.
- Maintenance work preparation and conduct are not always performed in a manner that ensures high quality of work.
- Workers putting items and tools on the floor without setting up a designated laying down area.
- Workers putting disassembled items and documents on the top of equipment.
- Weaknesses were identified in housekeeping and FME.
- Poor workmanship lead to events or rework.
- Workers were not using the required PPE during maintenance activities.
- Procedures were not strictly followed.

SSR-2/2 Rev.1
8.8. A comprehensive work planning and control system shall be implemented to ensure that work for purposes of maintenance, testing, surveillance and inspection is properly authorized, is carried out safely and is documented in accordance with established procedures.

8.9. An adequate work control system shall be established for the protection and safety of personnel and for the protection of equipment during maintenance, testing, surveillance and inspection. […]

- One issue is supporting the common finding in Commissioning area, paragraph 2.4.2.:
  - Inadequate practices in maintaining workplaces and local storages.
- The other issue was:
  - Insufficient reinforcement of expectations related to maintenance work practices.

2.4.6. Material condition

- Findings: 3 recommendations, 2 suggestions, 0 good practices
- Common finding: In a few plants, the material condition of equipment is inadequate to support safe and reliable operation. (4/15)

Examples show:

- Arrangements for monitoring material condition do not always ensure that degradation is identified, reported and corrected in a timely manner.
- Leak management program is not fully implemented to support reliable and safe conditions for plant systems and components.
- The corrosion and rusting were observed.
- Missing, degraded or damaged insulation were found.
- Cables were not properly fixed to cable trays.
- Oil or water leakage were observed.

SSR-2/2 Rev.1
Requirement 28: The operating organization shall develop and implement programmes to maintain a high standard of material conditions, housekeeping and cleanliness in all working areas.

7.10. […] Equipment that is degraded (owing to leaks, corrosion spots, loose parts or damaged thermal insulation, for example) shall be identified, reported and corrected in a timely manner.

- Common finding: In a few plants, Foreign Material Exclusion (FME) programme is not rigorously applied to prevent foreign material intrusion into systems and components related to safety. (2/15, including 1 suggestion from paragraph 2.3.4 in OPS)

Examples show:

– Various components were found open and lacking (or using unauthorized) FME covers during commissioning activities.
– Unnecessary items and foreign materials were observed inside a 'High risk FME area'
– Personnel were observed working in the Fuel Storage Pond area without maintaining the appropriate FME control log.
– Transparent plastic is widely used in Fuel Storage Pond area.
– Internal FME events were not incorporated into the training on FME.

SSR-2/2 Rev.1
7.11. An exclusion programme for foreign objects shall be implemented and monitored, and suitable arrangements shall be made for locking, tagging or otherwise securing isolation points for systems or components to ensure safety.

2.4.7. Work control

- Findings: 1 recommendation, 0 suggestions, 2 good practices
- No common finding
- The issue is:
  – Ineffective work control process to ensure that system, structures and components important to safety are repaired in a timely manner.
- Good practices are:
  – The use of electronic flow sheets with a visual status of plant work control and equipment configuration.
  – Implementation of a new process using a unique project management software tool to improve design modification management.

2.4.8. Spare parts and materials

- Findings: 2 recommendations, 0 suggestions, 1 good practice
- Common finding: In a few plants, spare parts are not always controlled with sufficient attention for their storage condition and availability. (2/15)

Examples show:

– Inappropriate storage of spare parts that does not guarantee that they remain in a suitable condition for operation.
– Spare parts are not always available in a timely manner to support the availability of safety related equipment and systems.

SSR-2/2 Rev.1
8.17. The operating organization shall ensure that materials, spare parts and components are available and in proper condition for use.

NS-G-2.6
8.23 The maintenance group should be responsible for ensuring that adequate spare parts and components, tools and resources for achieving its objectives are available. It should also be responsible for establishing stock levels and authorizing the issue and use of spare items and components.

- The good practice is:
  - Reverse-engineered parts, using laser scanning and additive technology (3D printing).

2.4.9. Outage management

- Finding: 0 recommendations, 0 suggestions, 1 good practice
- No common finding
- The good practice is:
  - A newly designed mobile power supply box which is used to transform the 24V power supply provided in the reactor building during outages to 220V to power instruments in the RCA.

2.4.10. Configuration control

- No finding

2.4.11. Use of PSA, PSR and OEF

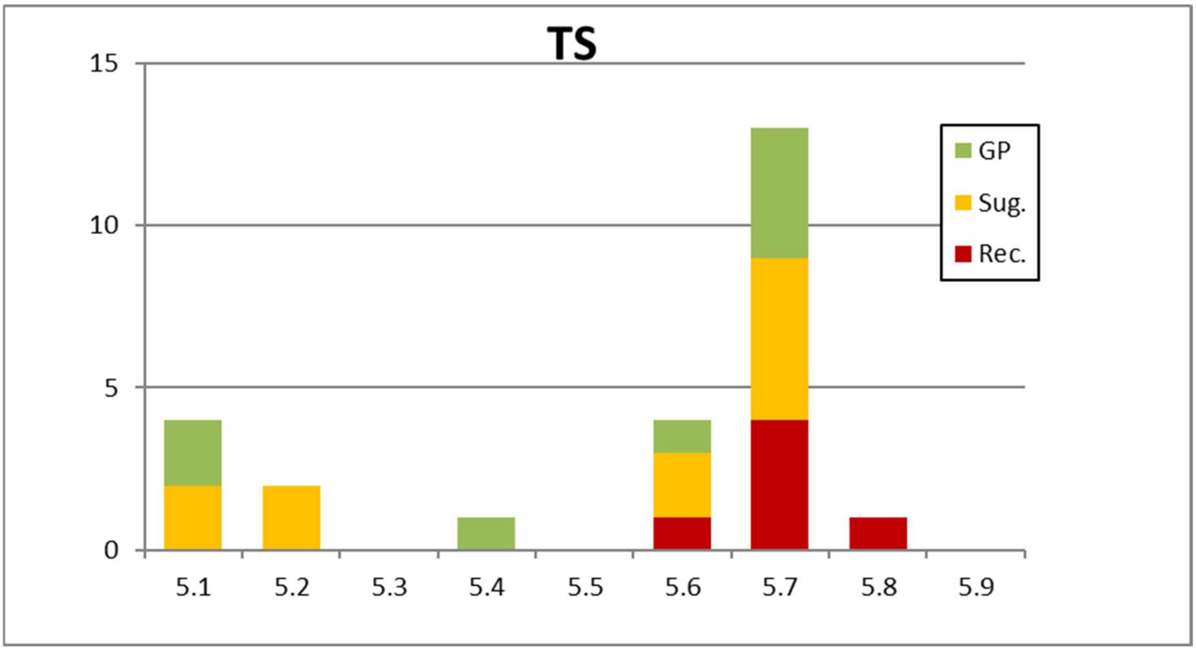
- No finding

2.5. Technical support

2.5.0. Summary of findings

The review of the TS area in the 15 visited NPPs resulted in 25 findings from which there are 6 recommendations, 11 suggestions and 8 good practices. The distribution of the findings between the different topics of the TS review is presented below:

Title		Rec.	Sug.	GP	Total
5.1	Organization and functions	0	2	2	4
5.2	Safety assessment	0	2	0	2
5.3	Programme for long-term operation	0	0	0	0
5.4	Ageing management	0	0	1	1
5.5	Use of PSA	0	0	0	0
5.6	Surveillance programme	1	2	1	4
5.7	Plant modification system	4	5	4	13
5.8	Reactor core management (reactor engineering)	1	0	0	1
5.9	Use of OEF	0	0	0	0
	Total	6	11	8	25



2.5.1. Organization and functions

- Findings: 0 recommendations, 2 suggestions, 2 good practices
- No common finding
- One issue is linked to the common finding on seismic housekeeping and control described in paragraph 2.5.7.
- Another issue is:
  - The knowledge and expertise within the operating organization regarding the plant design is not always sufficient to provide competent technical advice and ensure that the external Technical Support Organization has delivered appropriate information related to safety.

- Good practices are:
  - Application of automatic argon arc welding technique for austenitic piping, to reduce intergranular stress corrosion cracking.
  - Use of corrosion cards to easily report and categorise cases of corrosion, assign priorities and know the further actions associated with each priority.

2.5.2. Safety assessment

- Findings: 0 recommendations, 2 suggestions, 0 good practices
- <u>Common finding: In a few plants, the scope of the Periodic Safety Review (PSR) is not comprehensive enough to cover all plant facilities and all safety factors. (2/15)</u>

  Example show:

  - Plant waste management facilities are not included in the scope of the PSR. Although the plant implements an acceptable alternative to a full scope Periodic Safety Review it does not regularly re-evaluate all safety factors defined for Periodic Safety Reviews.

  SSR-2/2 Rev.1
  4.44. Safety reviews such as PSR or safety assessments under alternative arrangements shall be carried out throughout the lifetime of the plant […] and shall address, in an appropriate manner: the consequences of the cumulative effects of plant ageing and plant modification; equipment requalification; operating experience, including national and international operating experience; current national and international standards; technical developments; organizational and management issues; and site related aspects.

  4.46. The scope of the safety review shall include all safety related aspects of an operating plant.

2.5.3. Programme for long term operation

- No finding

2.5.4. Ageing management

- Finding: 0 recommendations, 0 suggestions, 1 good practice
- No common finding.
- The good practice is:
  - Ageing management daily walk-downs and focused walk-downs are conducted during the commissioning phase, to identify ageing effects of plant SSCs, focusing on the areas of susceptible deterioration based on OEF data.

2.5.5. Use of PSA

- No finding

2.5.6. Surveillance programme

- Findings: 1 recommendation, 2 suggestions, 1 good practice

- No common finding
- The issues are:
  - The surveillance programme does not always ensure that results from surveillance tests are used to trend, analyse and correct abnormal equipment conditions in a timely manner.
  - The equipment reliability programme is not always effective in preventing abnormal conditions that challenge operational safety.
  - The plant does not yet have an approved comprehensive plant surveillance programme and associated implementation procedures.
- The good practice is:
  - Establishment of an in-house R&D team and an Assessment Approval Committee for non-destructive and destructive examinations, failure analyses, as well as design and manufacturing of robots to be used in surveillance and recovery activities.

2.5.7. Plant modification system

- Findings: 4 recommendations, 5 suggestions, 4 good practices
- <u>Common finding: In some plants, temporary modifications are not adequately controlled to minimize their cumulative effect on plant safety. (5/15)</u>

  Examples show:

  - High numbers of temporary modifications are in place and which are not resolved in a timely manner.
  - No plant expectations or time limits for temporary modifications.
  - Temporary modifications not clearly identified at their location.
  - No updated list of all temporary modifications in the main control room.
  - No clear requirement for informing relevant staff in appropriate time of temporary modifications and of their consequences for the safe operation of the plant.

  SSR-2/2 Rev.1
  4.41. Temporary modifications shall be limited in time and number to minimize the cumulative safety significance. Temporary modifications shall be clearly identified at their location and at any relevant control position. The operating organization shall establish a formal system for informing relevant personnel in good time of temporary modifications and of their consequences for the operation and safety of the plant.

- <u>Common finding: In some plants, temporary or movable equipment and items near seismically qualified SSCs are not always identified, properly controlled and restrained to minimize their potential to affect safety related equipment. (4/15)</u>

  Examples show:

  - Unclear standards and expectations related to presence of moveable or temporary items in seismically qualified areas, and absence of marking of areas where precautions are needed.
  - The plant does not always control the presence of movable items in seismically qualified areas in a consistent manner. No periodic walk down to ensure that seismic requirements for movable items in the seismically qualified areas are strictly complied with.

– Presence of items not properly fixed within seismically qualified areas, including pieces of scaffolding, supports or moveable equipment temporarily stored without seismic evaluation.

SSR-2/2 Rev.1
4.38. Controls on plant configuration shall ensure that changes to the plant and its safety related systems are properly identified, screened, designed, evaluated, implemented and recorded.

4.48. Appropriate concepts and the scope and process of equipment qualification shall be established, and effective and practicable methods shall be used to upgrade and preserve equipment qualification.

- Common finding: In a few plants, permanent modifications are not always properly managed to ensure that they are effectively identified, screened, designed, assessed and implemented. (2/15)

  Examples show:

  – The modification programme does not always ensure that all modifications are properly identified, specified, screened, designed, evaluated and closed in an effective manner.
  – Permanent modifications are not always adequately implemented and there is sometimes an excessive backlog of modifications to be implemented.
  – Some incidents are caused by inadequate modification process.

  SSR-2/2 Rev.1
  4.39. A modification programme shall be established and implemented to ensure that all modifications are properly identified, specified, screened, designed, evaluated, authorized, implemented and recorded.

- Good practices are:

  – Innovative solution to leak check individual cable penetrations, without the need to conduct a full scale containment Leak Rate Test.
  – Extensive and early involvement of the Operations personnel in the design review.
  – Use of a risk-informed plant configuration control indicator to evaluate and inform the plant on the status of daily operational focus.
  – Use of process simulation to test and improve plant engineering process during design of modifications of process and automation systems.

2.5.8. Reactor core management (reactor engineering)

- Finding: 1 recommendation, 0 suggestions, 0 good practices
- No common finding
- The issue is:

  – Plant arrangements in commissioning phase associated with reactivity management do not ensure yet safe fuel and core conditions.

2.5.9. Use of OEF

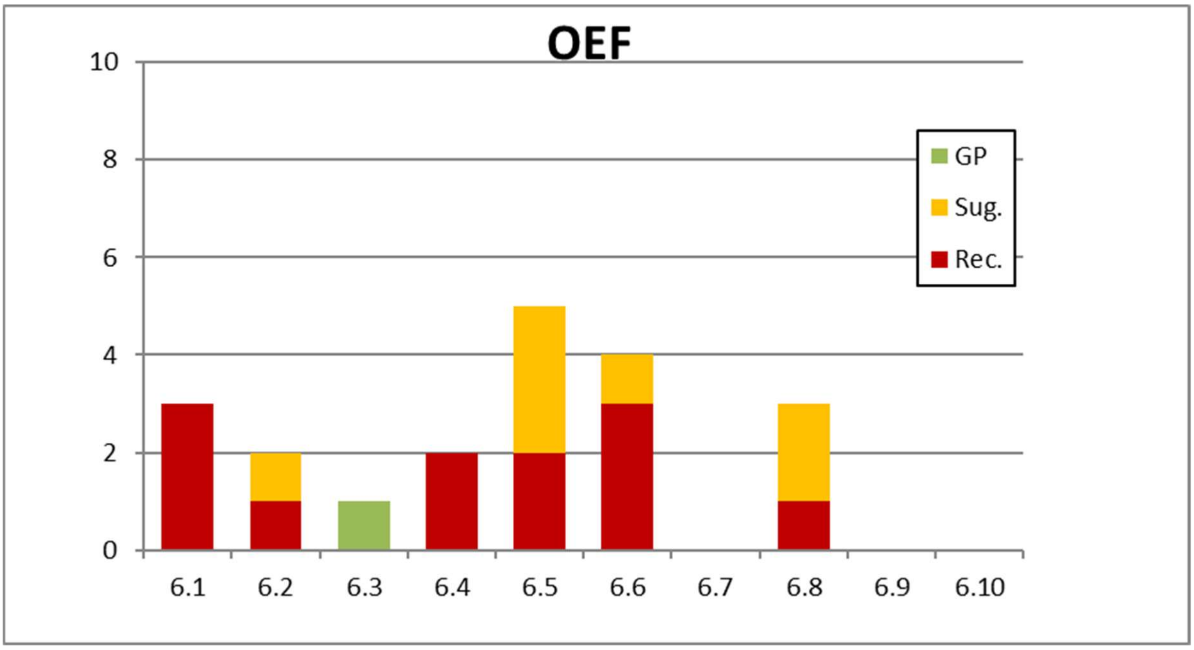
- No finding

2.6. Operational experience feedback

2.6.0. Summary of findings

The review of the OEF area in the 15 visited NPPs resulted in 20 findings from which there are 12 recommendations, 7 suggestions and 1 good practice. The distribution of the findings between the different topics of the OEF review is presented below:

Title		Rec.	Sug.	GP	Total
6.1	Organization and functions	3	0	0	3
6.2	Reporting of operating experience	1	1	0	2
6.3	Sources of operating experience	0	0	1	1
6.4	Screening of operating experience information	2	0	0	2
6.5	Investigation and analysis	2	3	0	5
6.6	Corrective actions	3	1	0	4
6.7	Utilization and dissemination of operating experience	0	0	0	0
6.8	Trending and review of operating experience	1	2	0	3
6.9	Effectiveness review of the operating experience programme	0	0	0	0
6.10	Use of PSA and PSR	0	0	0	0
	Total	12	7	1	20



2.6.1. Organization and functions

- Findings: 3 recommendations, 0 suggestions, 0 good practices
- No common finding
- The issues are:
  - The Operating Experience (OE) programme is not comprehensive regarding reporting, screening, analysing and trending operating experience, prioritizing corrective actions, and monitoring OE performance to prevent recurrent and/or significant events.
  - The plant does not ensure the timely analysis of plant condition requests and completion of corrective actions to minimize the risk from recurrence of events.

– Some elements of the OE process are not rigorously implemented in the areas of reporting, screening, trending and investigation.

2.6.2. Reporting of operating experience

- Findings: 1 recommendation, 1 suggestion, 0 good practices
- No common finding
- The issues are:
  - The plant expectations for identifying, reporting and trending of non-equipment related problems and near misses are not clearly established and effectively implemented (two other missions used similar facts in broader issues).
  - The plant process for event reporting is not consistently followed by all personnel.

2.6.3. Sources of operating experience

- Finding: 0 recommendations, 0 suggestions, 1 good practice
- The good practice is:
  - Sharing and evaluation of internal and external operating experience among a regional network of nuclear licensees.

2.6.4. Screening of operating experience information

- Findings: 2 recommendations, 0 suggestions, 0 good practices
- Common finding: in a few plants, the screening process is not robust enough to ensure that all events are categorized according to their significance. (2/15)

  Examples show:
  - Processes for event screening and categorization do not always ensure that events are assigned the appropriate priority and investigated in accordance with their actual or potential significance.
  - Some events with high safety significance do not lead to performing any root cause analysis.
  - Screening and categorizing based on a non-robust method.
  - Tendency to screen out non-domestic OE.
  - No record of the screening decision, inadequate screening committee composition, lack of timeliness of the screening.

  SSR-2/2 Rev.1
  5.28. Events with safety implications shall be investigated in accordance with their actual or potential significance. Events with significant implications for safety shall be investigated to identify their direct and root causes, including causes relating to equipment design, operation and maintenance, or to human and organizational factors.

2.6.5. Investigation and analysis

- Findings: 2 recommendations, 3 suggestions, 0 good practices

- Common finding: in some plants, the process for analysis of events does not ensure that events are always investigated with the necessary depth and timeliness. (4/15)

  Examples show:

  – Lack of quality and depth of event investigations. Limited use of extent of condition and cause. Inadequate training on event investigations.
  – Lack of timeliness of initiating and conducting event investigations.
  – Recurring events due to inadequate past event investigations.
  – Focus on troubleshooting rather than identifying underlying organizational causes.

  SSR-2/2 Rev.1
  5.28. Events with significant implications for safety shall be investigated to identify their direct and root causes, including causes relating to equipment design, operation and maintenance, or to human and organizational factors.

- One issue is supporting the common finding in paragraph 2.6.6..:

  – Event analysis, corrective actions and the use of operating experience are not sufficiently rigorous to prevent the recurrence of events.

2.6.6. Corrective actions

- Findings: 3 recommendations, 1 suggestion, 0 good practices
- Common finding: In some plants, corrective actions (CAs) are not always adequately defined and implemented in a timely manner to prevent event recurrence. (5/15 including 1 issue from paragraph 2.6.5)

  Examples show:

  – Recurring events due to known issues not solved in a timely manner, or to ineffective CAs.
  – Too many old, overdue or rescheduled CAs.
  – Some CAs incorrectly, partially, or not implemented at all.
  – Limited use of past relevant OE made to better formulate corrective actions. Some CAs not being specific, targeted, or measurable.
  – Inadequate tracking of CAs. Multiple and incomplete databases rendering overall tracking of corrective action progress more difficult.

  SSR-2/2 Rev.1
  5.30. As a result of the investigation of events, clear recommendations shall be developed for the responsible managers, who shall take appropriate corrective actions in due time to avoid any recurrence of the events. Corrective actions shall be prioritized, scheduled and effectively implemented and shall be reviewed for their effectiveness.

2.6.7. Utilization and dissemination of operating experience

- No finding

2.6.8. Trending and review of operating experience

- Findings: 1 recommendation, 2 suggestions, 0 good practices

- Common finding: In a few plants, events are not effectively trended to identify adverse trends in a systematic and consistent manner. (3/15)

  Examples show:

  – Limited or incomplete scope of the trending.
  – Some existing adverse trends not identified by the plant.
  – Absent, inconsistent or inadequate coding of issues hindering the trending effectiveness.
  – Use of multiple different databases with different coding systems hindering the trending effectiveness.
  – Adverse trends not formally reported, not analyzed or not addressed by corrective actions.

  SSR-2/2 Rev.1
  5.29. Information on operating experience shall be examined by competent persons for any precursors to, or trends in, adverse conditions for safety, so that any necessary corrective actions can be taken before serious conditions arise.

2.6.9. Effectiveness review of the operating experience programme

- No finding

2.6.10. Use of PSA and PSR

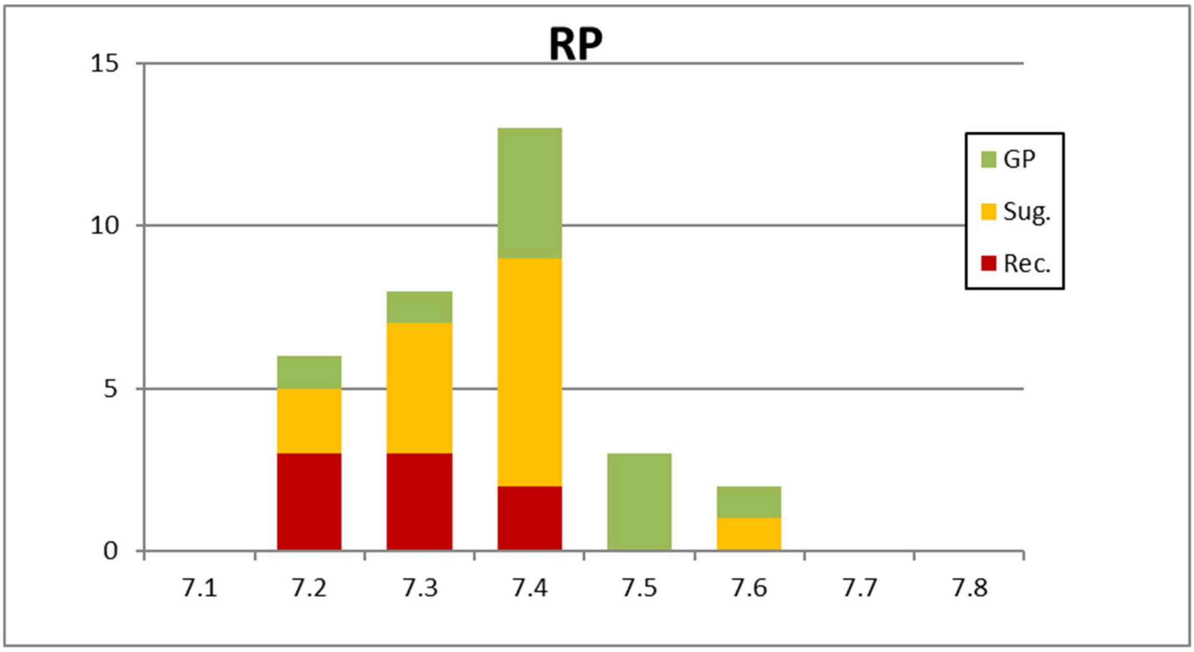
- No finding

2.7. Radiation protection

2.7.0. Summary of findings

The review of the RP area in the 15 visited NPPs resulted in 32 findings from which there are 8 recommendations, 14 suggestions and 10 good practices. The distribution of the findings between the different topics of the RP review is presented below:

Title		Rec.	Sug.	GP	Total
7.1	Organization and functions	0	0	0	0
7.2	Radiation protection policy	3	2	1	6
7.3	Radiation work control	3	4	1	8
7.4	Control of occupational exposure	2	7	4	13
7.5	Radiation protection instrumentation, protective clothing and facilities	0	0	3	3
7.6	Radioactive waste management and discharges	0	1	1	2
7.7	Radiation protection support during emergencies	0	0	0	0
7.8	Use of PSA, PSR and OEF	0	0	0	0
	Total	8	14	10	32



2.7.1. Organization and functions

- No finding

2.7.2. Radiation protection policy

- Findings: 3 recommendations, 2 suggestions, 1 good practice
- <u>Common finding: In a few plants, the staff do not demonstrate the commitment to radiation protection standards and do not have the required knowledge to implement them. (2/15)</u>

Examples show:

– The management expectations regarding radiation protection are not always adhered to by workers and radiation protection personnel in the field.
– A technician obtained a reactor coolant sample and spent fuel pool sample without verifying the dose rate before handling the radioactive material.
– Radiation protection technicians and work teams do not use the same radiological work permit; each person uses their own radiological work permit, with different settings.
– There is no programme to establish the initial and continuing training requirements for radiation protection personnel.

SSR-2/2 Rev.1
5.13. All plant personnel shall understand and acknowledge their individual responsibility for putting into practice the measures for controlling exposures that are specified in the radiation protection programme. Consequently, particular emphasis shall be given to the training of all site personnel so that they are aware of radiological hazards and of the necessary protective measures.

- Another issue is related to the plant's administrative limits regarding the dose to the lens of the eye do not ensure adequate protection of workers (3 other missions used the same fact regarding the dose to the lens of the eyes in other sub-areas).

- Two issues are supporting the common finding in paragraph 2.7.3.:

  – Dose constraints, postings of radiation levels and communication within the plant organization were not always effectively used to ensure radiation situational awareness at the plant and to keep dose As Low As Reasonably Achievable (ALARA).

  – The radiation contamination control programme is not always robust to ensure effective protection against contamination hazards at the plant.

- The good practice is:

  – The use of remotely controlled radio-frequency technology to simulate radiological conditions during training.

2.7.3. Radiation work control

- Findings: 3 recommendations, 4 suggestions, 1 good practice
- <u>Common finding: In some plants, the radiation work control practices are not adequate to prevent the spread of contamination. (5/15, including 1 issue from paragraph 2.7.2.)</u>

Examples show:

– A hand-foot-clothing monitor at the exit of the interim waste storage facility was found to have been inoperable for about a year due to high background activity. No action was initiated to resolve the issue, such as installing shielding. Instead, a portable contamination monitor was made available.
– The radiation-controlled area (RCA) layout allowed the possibility of exiting without passing through the contamination portal monitors.
– There is no programme to assess the surface contamination levels inside contaminated areas. Smears are made once every two weeks, but only outside posted contamination areas.

– The setpoint for the portal contamination monitor at the first barrier on the exit of the radiation-controlled area is set too high to be effective.

GSR Part 3
3.90. Registrants and licensees […] (d) shall establish measures for protection and safety, including, as appropriate, physical measures to control the spread of contamination and local rules and procedures for controlled areas […].

- Common finding: In a few plants, the barriers, signage and information posted are not sufficient to ensure that workers are aware of radiological conditions. (3/15, including 1 issue from paragraph 2.7.2.)

Examples show:

– According to a plant condition report, two employees, while conducting a walk down, entered a radiation-controlled area by mistake, without appropriate personal protective equipment and qualifications. There was a lack of physical barrier, lack of attention to details, and lack of situational awareness.
– A transportation door in the decontamination building did not have the required RCA signage on either side (RCA and outside).
– A cart containing pieces of pipes was found in the decontamination building without any signs or postings. The RP technicians had assumed that the pipes were clean, but a check with a radiation detector showed that it was radioactive and contaminated.

GSR Part 3
3.90. Registrants and licensees […] 3.90 Registrants and licensees […] (d) shall establish measures for protection and safety, including, as appropriate, physical measures to control the spread of contamination and local rules and procedures for controlled areas […].

NS-G-2.7
3.8. Warning symbols such as those recommended by the International Organization for Standardization (ISO) and appropriate information (such as radiation levels or contamination levels, the category of the zone, entry procedures or restrictions on access time, emergency procedures and contacts in an emergency) are required to be displayed at access points to controlled areas and specified zones and at other appropriate locations within the controlled area.

- The good practice is:

– A system that allows the alarms and operating status of the Radiation Controlled Area exit monitors to be remotely accessed from any networked personal computer in the plant.

2.7.4. Control of occupational exposure

- Findings: 2 recommendations, 7 suggestions, 2 good practices
- Common finding: In some plants, the ALARA programme is not comprehensive enough to drive continuous optimization of radiological work and does not fully address source term reduction to minimize doses to plant staff. (6/15)

Examples show:

– The KPI for annual collective dose while the plant is online is stable (not trending down), and the collective dose during outages is trending up.
– The plant has no performance indicator regarding the collective dose for recurring tasks (which could be used to identify adverse trends and the need for corrective actions).
– Access to the fuel transfer pit is via a very narrow corridor and stairway, which will make decontamination and maintenance activities very challenging. The plant is aware of the issue but has not requested mitigation measures before start-up.
– The plant dose constraint to workers is set at 80% of the regulatory dose limit (20 mS per year). Seventeen persons exceeded the dose constraint value (16 mSv per year), while remaining below the plant administrative dose limit (18 mSv per year). For these seventeen cases, measures to prevent exceedances of the dose constraints were not considered before starting the work; in effect the dose constraints were not used as boundary in the dose optimization process.
– The plant does not have a multidisciplinary group, comprising radiation protection, chemistry, operations, maintenance and engineering to manage source term reduction.

SSR 2/2 Rev.1
Requirement 8: The operating organization shall ensure that safety related activities are adequately analyzed and controlled to ensure that the risks associated with harmful effects of ionizing radiation are kept as low as reasonably achievable.

• <u>Common finding: In a few plants, the prevention, tracking and follow up of contamination events are not effective. (2/15)</u>

Examples show:

– Over 5000 alarms for personnel contamination were detected by the RCA's pre-monitors over the last year. Only 43 contamination events were analysed. An investigation level has not been established to trigger an investigation.
– Smear tests are performed on the floors in the RCA on a weekly basis to monitor for contamination, but no measurements are ever taken on the walls, which are assumed clean.

GSG 7
9.34. A contamination monitoring programme should be carried out as part of the prior radiological evaluation and ongoing safety assessments, and to verify the effectiveness of the measures for preventing and controlling surface contamination.

• Good practices are:

– A new design of shielding container reduces the dose to workers during any calibration of probes containing large sources.
– The display of current personal dose history information on entry to the RCA.
– A computer system equipped with badge recognition is used to control access to the building, to the source store room, and to the security safe that contains the sources.

2.7.5. Radiation protection instrumentation, protective clothing and facilities

- Findings: 0 recommendations, 0 suggestions, 3 good practices
- No common finding
- Good practices are:
  - A rotating shoe brush that removes contaminated particles from the sole has been developed featuring a HEPA suction system to contain radioactive particles.
  - An anemometer to visually monitor the airflow coming inside negative pressure tents, preventing the contamination spread.
  - Accurate heavy water leak rate determination through the use of the Tritium in Air Monitoring System (TAM) in inaccessible areas.

2.7.6. Radioactive waste management and discharges

- Findings: 0 recommendations, 1 suggestion, 1 good practice
- No common finding
- The issue is:
  - The radioactive waste management activities do not minimize the waste sent to the radioactive waste repository by sorting non-contaminated waste.
- The good practice is:
  - The use of a shredder for volume reduction of compactable, heterogeneous solid waste packaged in 220L drums.

2.7.7. Radiation protection support during emergencies

- No finding

2.7.8. Use of PSA, PSR and OEF

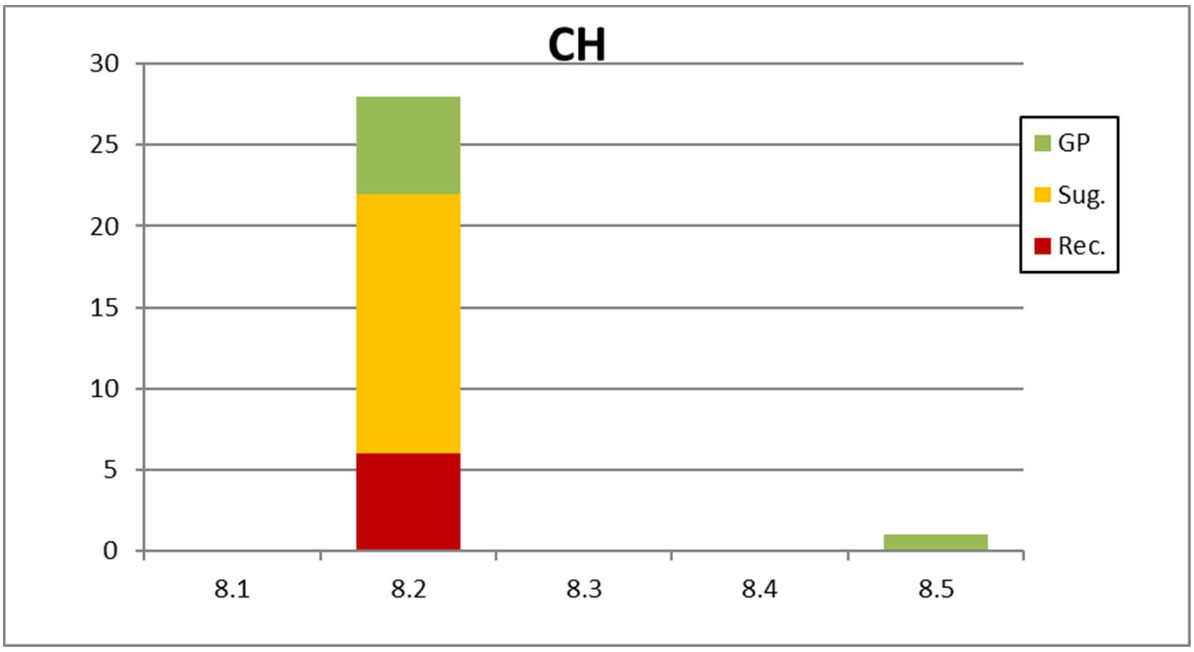
- No finding

2.8. Chemistry

2.8.0. Summary of findings

The review of the CH area in the 15 visited NPPs resulted in 29 findings from which there are 6 recommendations, 16 suggestions and 7 good practices. The distribution of the findings between the different topics of the CH review is presented below:

Title		Rec.	Sug.	GP	Total
8.1	Organization and functions	0	0	0	0
8.2	Chemistry programme	6	16	6	28
8.3	Occupational radiation exposure	0	0	0	0
8.4	Control of plant configuration	0	0	0	0
8.5	Use of PSA, PSR and OEF	0	0	1	1
	Total	6	16	7	29



2.8.1. Organization and functions

- No finding

2.8.2. Chemistry programme

- Findings: 6 recommendations, 16 suggestions, 6 good practices
- Common finding: In many plants, the control and storage of chemicals and substances used in the plant are not always effective to preserve the integrity and availability of the plant systems. (8/15)

  Examples show:

  - Some different chemicals were found without an expiry date or expired in a cabinet at the control maintenance calibration shop in the service building.
  - Concentrated ammonia was stored in a cabinet dedicated to the storage of acids.
  - About 500ml of transferred chemical substance was stored in an unapproved glass jar.

– Diesel fuel, hydrochloric-acid, sodium-hydroxide, hydrazine, morpholine were found in the plant without quality qualification and no testing.

SSG-13
9.2. The operating organization should be responsible for the use of the proper chemicals and for their correct quality.

9.8. When receiving chemicals, the specified quality should be verified by chemical analysis and/or by a certificate and a chemical identification test.

9.9. Chemicals and substances should be labelled according to the area in which they are permitted to be used, so that they can be clearly identified. The label should indicate the shelf life of the material.

9.10. When a chemical is transferred from a stock container to a smaller container, the latter should be labelled with the name of the chemical, the date of transfer and pictograms to indicate the risk and application area. The contents of the smaller container should not be transferred back into stock container.

- Common finding: In many plants, the chemistry monitoring programme is not sufficiently comprehensive to provide an effective evaluation of plant chemical operational conditions and parameters. (8/15)

Examples show:

– The pH in the Primary Heat Transport (PHT) system was slightly increased to reduce the deposition of magnetite on fuel bundles. The influence of this increase on the integrity of the PHT is not comprehensively monitored as the release and transport of single corrosion products (Fe, Ni, and Cu) are not measured.
– Ten out of 34 on-line measurement parameters were not available due to problems with the hot well sample booster pumps and the analyser.
– On-line instruments which were not working properly were left in service, displaying incorrect values on the analysers. The plant did not tag instruments out of service to prevent erroneous readings from being recorded.
– The procedures related to sampling and analysis of chemical parameters do not specify that the frequency of these activities should be increased when conditions such as out of specifications or degrading trends are identified.
– To protect the secondary side against corrosion the plant has set the pH in this system between 9,5 to 9,6. The absolute maximum limit is 9,8. Trending diagrams presented at the time of the mission show that the pH of on the secondary side was above the limit of 9,8 on three instances over the last three years.
– The plant practice for sampling Steam Generator Feed Water with a weekly grab sample does not provide an accurate iron monitoring to protect the steam generators and support compliance with the plant Technical Specifications.
– Independent laboratory analysis confirmed the presence of general corrosion, accelerated by microbiologically influenced corrosion (MIC) in an elbow with a thru-wall failure downstream of the component cooling heat exchanger. Prior to last year, sampling and analyses for MIC had not been performed for the non-safety and safety related service water system and for the fire protection piping.

SSR-2/2 Rev.1

7.14. Chemistry surveillance shall be conducted at the plant to verify the effectiveness of chemistry control in plant systems and to verify that structures, systems and components important to safety are operated within the specified chemical limit values.

SSG-13
3.4. In the chemistry programme, it should be ensured that […] there is a timely response to correct any deviations from normal operational status, such as small deficiencies, adverse trends or fast transients of chemistry parameters.

6.14. On-line chemistry monitoring and data acquisition systems should be used that accurately measure and record data and provide alarms for key chemistry parameters.

- Common finding: In a few plants, equipment supporting the control of chemistry conditions (such as pumps and tanks) is not always maintained available to prevent the potential of adverse system component corrosion or fouling. (2/15)

Examples show:

– The indicator for chemistry hours out of specification is improving but still trending adversely over target, e.g. calandria vault dryer unavailability influences this indicator; the calandria vault humidity has a strong influence on corrosion processes in the vault.
– Circulating water hypochlorite dosing system failures have resulted in over 50% insufficient treatment time in the last four months and failures have been reported every month over the last year.

SSR-2/2 Rev.1
7.13. […] The chemistry programme shall provide the necessary information and assistance for chemistry and radiochemistry for ensuring safe operation, long term integrity of structures, systems and components, and minimization of radiation levels.

8.1. Maintenance, testing, surveillance and inspection programmes shall be established that include predictive, preventive and corrective maintenance activities. These maintenance activities shall be conducted to maintain availability during the service life of structures, systems and components by controlling degradation and preventing failures. In the event that failures do occur, maintenance activities shall be conducted to restore the capability of failed structures, systems and components to function within acceptance criteria.

- Other issues are:

– A comprehensive management programme of calibration and maintenance, of analytical laboratory equipment and online monitors has not been established to ensure adequate and continuous systems monitoring.
– Chemistry instruments and equipment are not always maintained in good condition (show sign of corrosion) to ensure accurate analyses.

- Good practices are:

– On-line purification and cleaning of stator cooling system using ion-exchange resins to make copper oxides soluble and capture them.
– A detailed procedure with rigorous chemical and radiochemical criteria for controlling the chemistry conditions during plant shutdown. This has led to one of the lowest source terms in the fleet.

– A systematic anti-corrosion management programme for equipment and buildings at the design phase of the plant construction project.
– Equipment that periodically injects an organic scale removal product into the circulating water system to prevent scale and sludge deposits in the condenser and circulating water systems. The product used is organic, harmless for the environment and contains neither phosphate nor nitrogen.
– Strategies for reducing corrosion products transport for Steam Generators (SGs) that include: reducing the impurity ingress to SGs, using high pH strategy; decreasing the intake of erosion-corrosion products into SGs by means of FFA injection technology before shutdown, and Ethanolamine injection during normal operation; removing the accumulated sludge during outages.
– A unique method for performing a visual suspended solids analyses using a microscope and camera combination that makes it possible to quickly detect wear, foreign material and many other kinds of failures from process samples.

2.8.3. Occupational radiation exposure

- No finding

2.8.4. Control of plant configuration

- No finding

2.8.5. Use of PSA, PSR and OEF

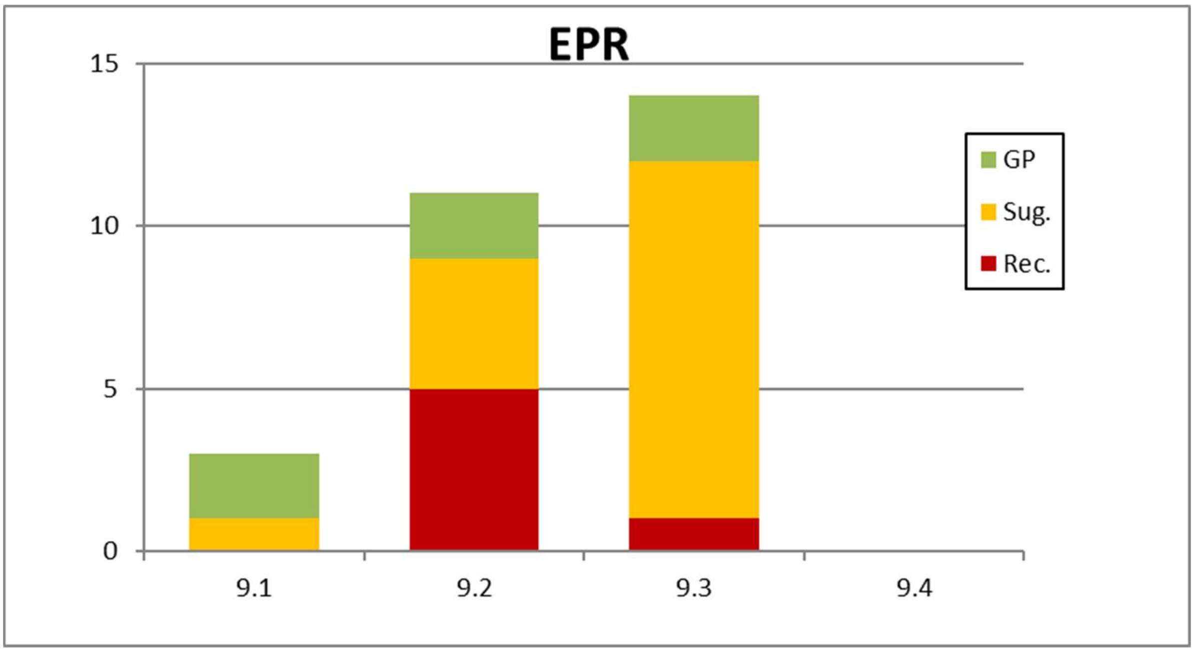
- Finding: 0 recommendations, 0 suggestions, 1 good practice
- No common finding
- The good practice is:
  – A feed through line has been designed and manufactured to connect the inside of the sampling glove box with a portable gas analyser located outside the glove-box. This modification allows a more precise and fast analysis which minimizes the operator’s dose intake and provides effective support for the adjustment of the water-chemical regime (ammonia injection) to control oxygen and hydrogen in the PHT.

2.9. Emergency preparedness and response

2.9.0. Summary of findings

The review of the EPR area in the 14 visited NPPs resulted in 28 findings from which there are 6 recommendations, 16 suggestions and 6 good practices. The distribution of the findings between the different topics of the EPR review is presented below:

Title		Rec.	Sug.	GP	Total
9.1	Organization and functions	0	1	2	3
9.2	Emergency response	5	4	2	11
9.3	Emergency preparedness	1	11	2	14
9.4	Use of PSR and OEF	0	0	0	0
	Total	6	16	6	28



2.9.1. Organization and functions

- Findings: 0 recommendations, 1 suggestion, 2 good practices
- No common finding
- The issue is:
  - The plant has not benchmarked its protective actions, defined in the On-site Emergency Response Plan, covering all potentially affected areas within the emergency planning zones, to ensure protective action recommendations are coordinated.
- Good practices are:
  - A set of special arrangements to assist the family and relatives of emergency personnel and ensure their welfare.

2.9.2. Emergency response

- Findings: 5 recommendations, 4 suggestions, 2 good practices
- Common finding: In some plants, not all emergency response arrangements described in the emergency plan have been validated during exercises. (4/14)

  Examples show:

  – The Emergency Response Organization functions involved in deploying emergency mobile equipment for severe accident management remains to be confirmed and validated by partial and integrated tests and drills, planned to be performed before core loading.
  – The alternate alerting process of off-site personnel by the Rescue Service (used as a backup for the alert from the Main Control Room) has never been tested during a joint exercise with the plant.
  – The provision of recommendations to the local authorities has not been rehearsed during an exercise in the past few years.
  – The plant has not yet conducted an emergency exercise that includes harsh radiological conditions on-site. The post-Fukushima national exercise completed by the plant involved a design basis accident scenario without a release to the environment.
  – The plant did not perform any emergency drill and exercise involving both units for design extension conditions.

  SSR-2/2 Rev.1
  5.6. The emergency plan shall be tested and validated in exercises before the commencement of fuel loading. Emergency preparedness training, exercises and drills shall be planned and conducted at suitable intervals, to evaluate the preparedness of plant staff and staff from external response organizations to perform their tasks, and to evaluate their cooperation in coping with an emergency and in improving the efficiency of the response.

- Common finding: In a few plants, the arrangements during emergency response are not sufficient to ensure the protection of all persons on site. (3/14)

  Examples show:

  – Assembly points do not include clean water supply for taking iodine tablets.
  – Under an agreement between the plant and a bus company, 3 buses must at the site within 60 minutes for the evacuation of up to 4000 workers.
  – The assembly points under the control of the plant offer limited protection against a radiological release.
  – There is no radiation monitoring available at the assembly point to verify the habitability. The emergency support group must send a team to survey each assembly point with portable survey equipment.

  GSR Part 7
  5.41. The operating organization of a facility in category I, II or III shall make arrangements to ensure protection and safety for all persons on the site in a nuclear or radiological emergency. The arrangements […] shall also include ensuring the provision, for all persons present in the facility and on the site, of suitable assembly points, provided with continuous radiation monitoring.

- Other issues are:
  - The on-site emergency plan does not fully address the effect of high radiation levels and contamination on site that could impair the response by plant personnel.
  - The plant is not sufficiently prepared to manage the radioactive waste that could be generated during an emergency.
- Two issues are supporting the common finding in paragraph 2.9.3.:
  - The plant's emergency facilities are not sufficiently protected and equipped to ensure long term effective implementation of the emergency response actions and protection of the personnel.
  - The plant's emergency facilities are not sufficiently robust to ensure effective implementation of the emergency response actions and the emergency response arrangements in respect of training, guidance and equipment are not sufficiently comprehensive to protect personnel after a significant radioactive release.
- Good practices are:
  - The plant has an agreement with the postal service so that new residents of the distribution zone are identified three times per year by the postal service and provided with information packages with Potassium Iodide tablets.
  - Protection of emergency responders from skin contact to radioactive water with a beta-hood that adds a covering to the shoulders of the responders.

2.9.3. Emergency preparedness

- Findings: 1 recommendation, 11 suggestions, 2 good practices

<u>Common finding: In many plants, the arrangements for the preparedness of emergency facilities and equipment are not always adequate. (8/14, including 2 issues from paragraph 2.9.2.)</u>

Examples show:

- The following expired equipment and supplies were found in the Emergency Response Centre Control Room despite the fact that these need to be inspected every six or twelve months according to the plant expectations: batteries, rubber gloves, instant soup packages.
- In multi-unit accidents, the display of plant parameters from both units is not possible in any of the plant emergency control centres.
- The plant has no dedicated equipment at the off-site rescue service for decontamination of plant personnel in an emergency situation requiring evacuation of the plant.
- The back-up Off-site Emergency Response Centre has no filtered air ventilation system.
- The room for the Severe Accident Management coordination group does not have seismic qualification and auxiliary power supply system.

SSR-2/2 Rev.1
5.7. Facilities, instruments, tools, equipment, documentation and communication systems to be used in an emergency, including those needed for off-site communication and for the accident management programme, shall be kept available. They shall be maintained in good operational condition in such a manner that they are unlikely to be affected by, or made unavailable by accidents. The operating organization shall ensure that relevant information

on safety parameters is available in the emergency response facilities and locations, as appropriate, and that communication between the control rooms and these facilities and locations is effective in the event of an accident.

- Common finding: In a few plants, the drills and exercises programme is not rigorous enough to identify and implement improvement opportunities. (2/14)

  Examples show:

  – The feedback from drills is not systematic and sufficiently comprehensive. For example, operations teams perform a Self-Assessed Crew Practice twice a year. However, the summary report is not mandatory, and some are empty of any comment.
  – There are no drills or exercises without previous notification in or outside of working hours to assess the accomplishment of non-routine tasks under stressful emergency conditions.
  – Each emergency response staff member participates in an emergency response drill once a year. These drills do not require the participation of other emergency response organization groups, interaction with staff in the field or local emergency centres. As a result, these drills do not allow staff members to obtain practical experience on coordination with different parts of the emergency organization.

  GSR Part 7
  6.30. Exercise programmes shall be developed and implemented to ensure that all specified functions required to be performed for emergency response, all organizational interfaces for facilities in category I, II or III, and the national level programmes for category IV or V are tested at suitable intervals. These programmes shall include the participation in some exercises of, as appropriate and feasible, all the organizations concerned, people who are potentially affected, and representatives of news media. The exercises shall be systematically evaluated, and some exercises shall be evaluated by the regulatory body. Programmes shall be subject to review and revision in the light of experience gained.

- Other issues are:

  – The plant should consider revising the arrangements for activation of the Emergency Response Organization to ensure an efficient and coordinated use of emergency response organization resources, so that the emergency response capability is maintained at all times.

  – The plant should improve its emergency preparedness arrangements and practical training to cover all the anticipated emergency aspects.

- Good practices are:

  – The on-line monitoring system has a software capability to simulate gamma radiation fields at all gamma monitoring stations during emergency exercises to make the scenarios more realistic.

  – Transportable container for personal protective equipment and radiation monitoring measuring instruments. The container located at a central off-site facility can be transported to the site of an accident during an emergency.

2.9.4. Use of PSR and OEF

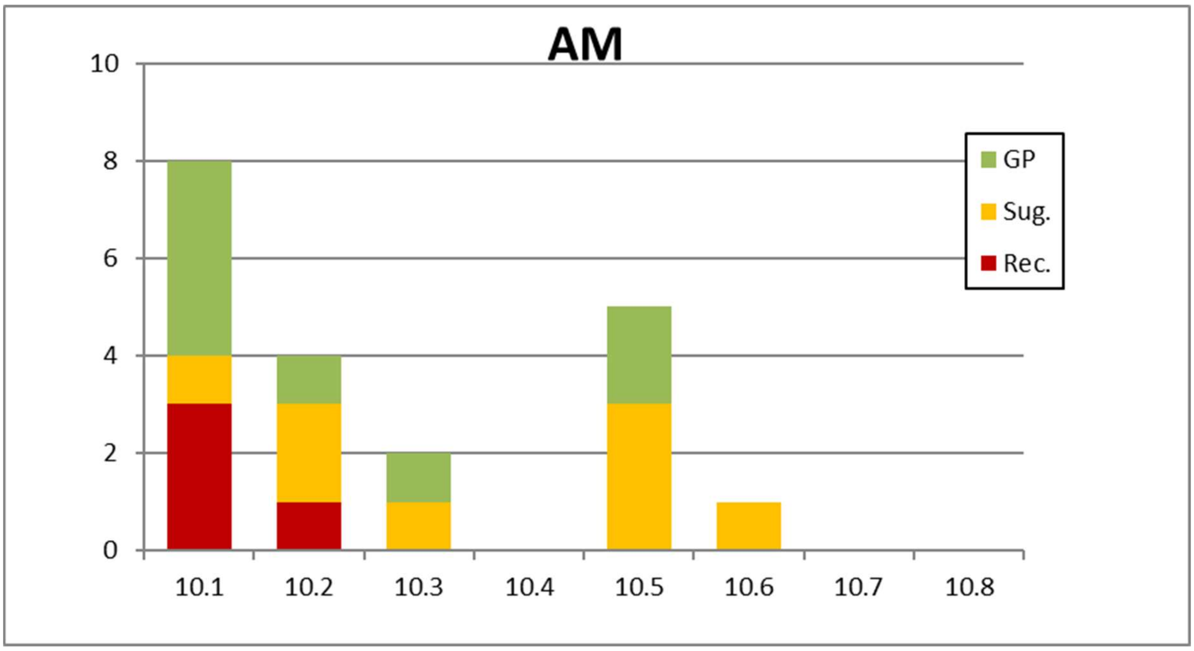
- No finding

2.10. Accident management

2.10.0. Summary of findings

The review of the AM area in the 15 visited NPPs resulted in 20 findings from which there are 4 recommendations, 8 suggestions and 8 good practices. The distribution of the findings between the different topics of the AM review is presented below:

Title		Rec.	Sug.	GP	Total
10.1	Organization and functions	3	1	4	8
10.2	Overview of the severe accident management programme	1	2	1	4
10.3	Analytical support for severe accident management	0	1	1	2
10.4	Development of procedures and guidelines	0	0	0	0
10.5	Plant emergency arrangements with respect to SAM	0	3	2	5
10.6	Verification and validation of procedures and guidelines	0	1	0	1
10.7	Control of plant configuration	0	0	0	0
10.8	Use of PSA, PSR and OEF	0	0	0	0
	Total	4	8	8	20



2.10.1. Organization and functions

- Findings: 3 recommendations, 1 suggestion, 4 good practices
- Common finding: In a few plants, the scope of exercises/drills and effectiveness of training programmes are insufficient to ensure adequate level of knowledge and capability to respond to severe accident. (3/15, including 1 issue from paragraph 2.10.5.)

  Examples show:

  – No drills for the emergency response personnel performed in which the actual Severe Accident Management Guidelines were employed.

– No table-top exercises have been conducted to familiarize the relevant personnel on use of the Severe Accident Management Guidelines.
– Not always refresher training on severe accidents is provided in accordance with the recommended periodicity.
– In a few cases, training on Severe Accident Guidelines is provided only in the form of table top training for a new person.
– Sometimes emergency exercises are performed on scenarios that do not use Severe Accident Management Guidelines.

SSR-2/2 Rev.1
5.8. An accident management programme shall be established that covers the preparatory measures, procedures and guidelines, and equipment that are necessary for preventing the progression of accidents, including accidents more severe than design basis accidents, and for mitigating their consequences if they do occur. The accident management programme shall be documented and shall be periodically reviewed and as necessary revised.

5.8E. The accident management programme shall include training necessary for implementation of the programme.

SSG-54
3.114. Training, including periodic exercises and drills, should be sufficiently realistic and challenging to prepare personnel responsible for severe accident management duties to cope with and respond to situations that may occur during an event.

- Other issues are:
  – Insufficient support, training and documented guidance for the SAMGs users.
  – Inefficient review and update of the Severe Accident Management programme.

- Good practices are:
  – Pre-Job Brief videos created to reinforce consistent deployment of plant-specific mobile emergency equipment.
  – Integrated information system (accessible on- and off-site) which makes SAMG documentation, decision log information and station documentation available to the technical support centre personnel.
  – An overall Emergency Management Guideline flowchart, which provides a comprehensive overview of all strategies, guidelines and other relevant documents that can be used by responsible decision makers for coping with extreme events or extensive damage to plant components.
  – Use of a Full-Scope Simulator equipped with a mobile emergency equipment extension module for training, plant emergency exercises and comprehensive emergency drills of severe accident scenarios.

2.10.2. Overview of the severe accident management programme

- Findings: 1 recommendation, 2 suggestions, 1 good practice

- Common finding: In a few plants, the scope of the severe accident management guidelines is not broad enough to include severe accidents with an open primary system, multi-unit events and accidents involving spent fuel pools. (2/15)

  Examples show:

  - The scope of the Severe Accident Management Guidelines is limited to plant states with the primary system closed.
  - Strategy to address severe accidents in the spent fuel pools has not been developed.
  - No specific procedure, strategy or clear prioritization on how to proceed in the case of both units simultaneously undergoing a severe accident when two units share the same filtered venting system which is dimensioned for only one unit.
  - The local technical support centre facility is currently designed to only display information from one unit (one screen that can be connected to the plant parameter monitoring system) in the event of a severe accident affecting two units.

  SSR-2/2 Rev.1
  5.8A. For a multi-unit nuclear power plant site, concurrent accidents affecting all units shall be considered in the accident management programme. Trained and experienced personnel, equipment, supplies and external support shall be made available for coping with concurrent accidents. Potential interactions between units shall be considered in the accident management programme.

  SSG-54
  2.11. The accident management programme should address all modes and states of operation and all fuel locations, including the spent fuel pool, and should take into account possible combinations of events that could lead to an accident.

- The other issue is:
  - Insufficient arrangements for accident management to fully address the mitigation of severe accidents.

- The good practice is:
  - A comprehensive Accident Management Programme supported by a set of severe accident analyses and design phase PSA level 2 and which complements design features with the equipment and measurements that have been widely qualified to severe accident conditions.

2.10.3. Analytical support for severe accident management

- Findings: 0 recommendations, 1 suggestion, 1 good practice
- No common finding
- The issue is related to not finalized arrangements for the ongoing external support needed for completion and updating severe accident management programme.
- The good practice is:
  - Severe Accident Software Simulator application for supporting multi-unit severe accident management guideline development.

2.10.4. Development of procedures and guidelines

- No finding

2.10.5. Plant emergency arrangements with respect to SAM

- Findings: 0 recommendations, 3 suggestions, 2 good practices
- Common finding: In a few plants, the arrangements for use of Severe Accident Management Equipment are not sufficient to demonstrate the deployment and capability of the mobile accident management equipment. (2/15)

  Examples show:

  – The mobile pumps at river water intake facility haven't been tested and can't be used during drills.
  – Some SAMG related mobile equipment is stored in a building which is not flood protected to the same level as the Nuclear Island.
  – The mobile accident management equipment was stored in environmental conditions(heat, dust, humidity) which could adversely affect its operability.
  – Mobile Accident Management equipment has not been mobilized during any drills.

  SSR-2/2 Rev.1
  5.8C. The accident management programme shall include contingency measures, such as an alternative supply of cooling water and an alternative supply of electrical power, to mitigate the consequences of accidents, including any necessary equipment. This equipment shall be located and maintained so as to be functional and readily accessible when needed.

  SSG-54
  3.68. All equipment necessary for the severe accident management programme, including non-permanent equipment if any, should be tested in accordance with the importance of the equipment to fulfilling the fundamental safety functions.

- The other issue is supporting the common finding in paragraph 2.10.1.:

  – Insufficient practical training for appointed emergency responders involved in the management of severe accidents.

- Good practices are:

  – Software application to estimate personnel dose during the implementation of field response actions in case of severe accident.

  – Large number of clearly labelled suction options for use of mobile pumps to make-up to the Primary Circuit, Spent Fuel Pool and Steam Generators.

2.10.6. Verification and validation of procedures and guidelines

- Finding: 0 recommendations, 1 suggestion, 0 good practices
- No common finding

- The issue is:
  - Incomplete validation of the Accident Management procedures and guidelines that does not address all parts of AM and does not consider all the possible site habitability and environmental conditions.

2.10.7. Control of plant configuration

- No finding

2.10.8. Use of PSA, PSR and OEF

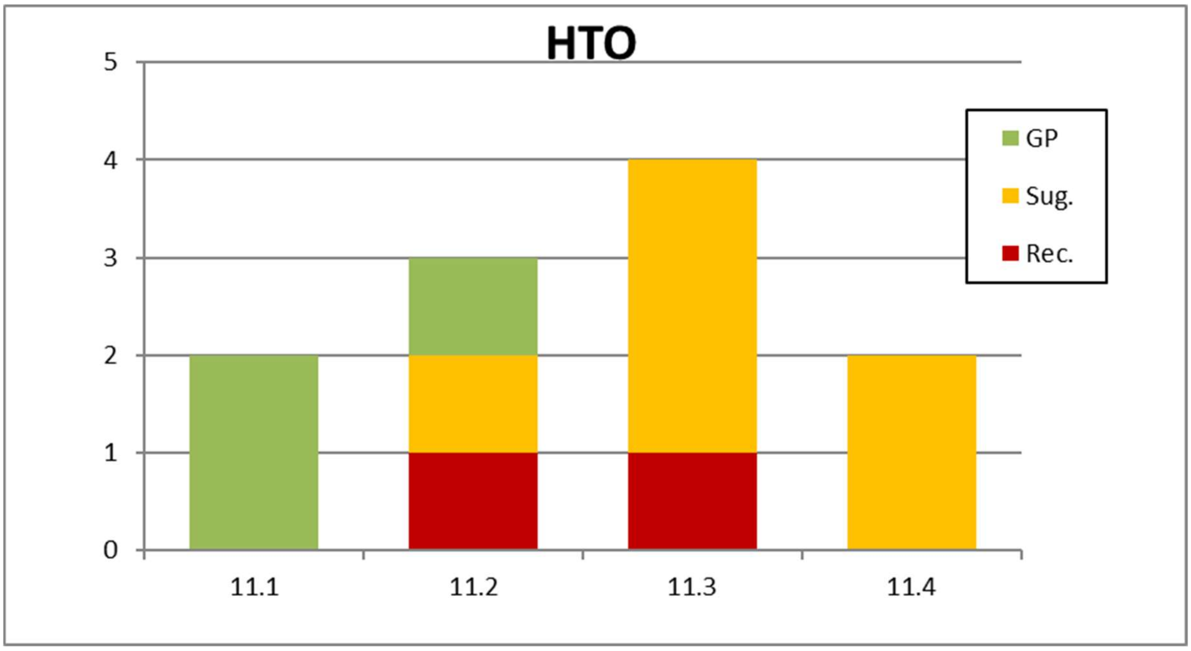
- No finding

2.11. Human-technology-organization interaction

2.11.0. Summary of findings

The review of the HTO area in the 11 visited NPPs resulted in 11 findings resulting in 2 recommendations, 6 suggestions and 3 good practices. The distribution of the findings between the different topics of the HTO review is presented below:

Title		Rec.	Sug.	GP	Total
11.1	Interfaces and relationships	0	0	2	2
11.2	Human factors management	1	1	1	3
11.3	Continuous improvement/learning organization (monitoring and assessment)	1	3	0	4
11.4	Safety culture	0	2	0	2
	Total	2	6	3	11



2.11.1. Interfaces and relationship

- Findings: 0 recommendations, 0 suggestions, 2 good practices
- No common finding
- Good practices are:
  - The plant has fostered a longstanding positive relationship with community partners to develop young leaders and improve environmental stewardship and awareness.
  - The development of a recruitment programme that allows new staff to gain significant knowledge and experience from peers prior to starting a role and for the existing staff to benefit from the new capabilities being brought by the new staff.

2.11.2. Human factors management

- Findings: 1 recommendation, 1 suggestion, 1 good practice

- <u>Common finding: In a few plants, human performance tools are not comprehensively and consistently applied and reinforced. (2/11)</u>

  Examples show:

  - The management system and associated plant activities do not fully support an effective implementation, use and reinforcement of Human Performance tools:
    - There are no common, clearly documented requirements in place,
    - There is no formal Human Performance strategy or implementation plan in place,
    - The use of Human Performance tools is not required for all departments,
    - There are weaknesses in the use of Human Performance tools training.
  - Human performance tools are not comprehensively and consistently applied in the daily work to ensure that human errors are minimized. There are weaknesses in:
    - Procedure use and adherence,
    - Pre-Job Briefings,
    - 3-way communication training.

  SSR-2/2 Rev.1
  4.29. Aspects of the working environment that influence human performance factors (such as workload or fatigue) and the effectiveness and fitness of personnel for duty shall be identified and controlled. Tools for enhancing human performance shall be used as appropriate to support the responses of operating personnel.

- The good practice is:

  - The plant's training department has used digital technologies in an innovative way to reinforce the use of Human Performance (HU) tools.

2.11.3. Continuous improvement/learning organization (monitoring and assessment)

- Findings: 1 recommendation, 3 suggestions, 0 good practices
- <u>Common finding: In a few plants, continuous improvements are not effectively promoted, pursued and reinforced. (3/11)</u>

  Examples show:

  - The continuous improvements in some important areas are not effectively pursued to ensure challenges to operational safety are minimized. There are weaknesses in: Maintenance backlogs; Fuel handling machine reliability; Outage planning and execution.
  - The leaders and management do not use all the available opportunities and company arrangements for continuous promotion, reinforcement and enhancement of safety performance in all activities. There are weaknesses in: Setting goals; Corrective actions; Acting on feedback for improvement; Behaviours of workers in the field.
  - The station's efforts to meet its own expectations for improvements in the management system related to human performance, leadership coaching, and process improvement are not sufficient to improve plant performance. There are weaknesses in: Cross-functional coordination; Focus Areas have not meet expectations.

GSR Part 2
3.2. Managers at all levels in the organization, taking into account their duties, shall ensure that their leadership includes:
(a) Setting goals for safety that are consistent with the organization's policy for safety, actively seeking information on safety performance within their area of responsibility and demonstrating commitment to improving safety performance.

- The other issue is:
  - Knowledge management is not systematically implemented at the station to ensure effective acquisition, transformation, transfer and retention of knowledge.

2.11.4. Safety culture

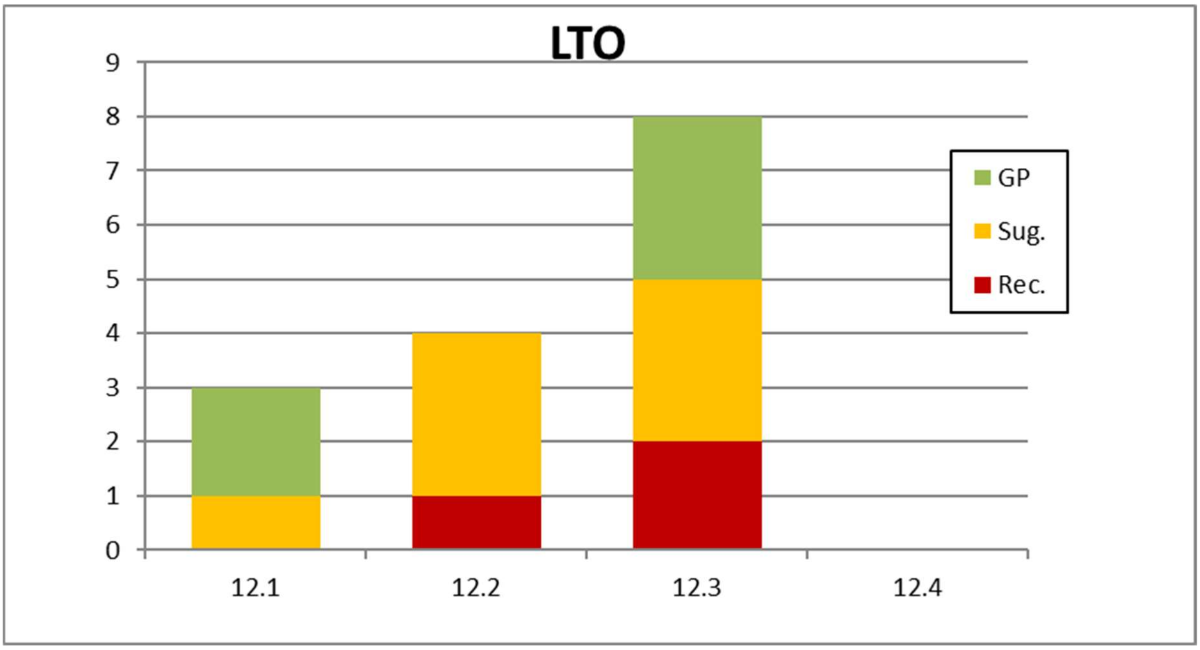
- Findings: 0 recommendations, 2 suggestions, 0 good practices
- No common finding
- The issues are:
  - The procedure for nuclear safety culture self-assessments does not include a sufficiently diverse range of tools necessary to gather all the information required for effective analysis.
  - The plant's tools, techniques and performance indicators for nuclear safety culture self and independent assessment are not sufficient to fully assess nuclear safety culture.

2.12. Long term operation

2.12.0. Summary of findings

The review of the LTO area in the 8 visited NPPs resulted in 15 findings resulting in 3 recommendations, 7 suggestions and 5 good practices. The distribution of the findings between the different topics of the LTO review is presented below:

Title		Rec.	Sug.	GP	Total
12.1	Organization and functions	0	1	2	3
12.2	Scoping and screening, and plant programmes relevant to LTO	1	3	0	4
12.3	Review of ageing management and ageing management programmes, and revalidation of time limited ageing analyses	2	3	3	8
12.4	Use of PSR and OEF	0	0	0	0
	Total	3	7	5	15



2.12.1. Organization and functions

- Findings: 0 recommendations, 1 suggestion, 2 good practices
- No common finding
- The issue is supporting the common finding in paragraph 2.12.2.:
  - Insufficient documentation and traceability of the scoping and screening process to ensure that the safe operation of systems, structures and components (SSCs) is guaranteed to continue during the LTO period.
- Good practices are:
  - Obsolescence management taking into consideration the long-term ageing management assessments and transition to decommissioning requirements.
  - Integrated asset management system to manage and trend plant risk and investment.

2.12.2. Scoping and screening, and plant programmes relevant to LTO

- Findings: 1 recommendation, 3 suggestions, 0 good practices
- Common finding: In many plants, the LTO scoping and screening is incomplete, not finalized or not well documented to enable scope completeness review and verification. (5/8, including 1 issue from paragraph 2.12.1.)

  Examples show:

  – Scoping and screening for LTO is based only on maintenance classification and safety classification. The completeness of the LTO scoping and screening cannot be demonstrated.
  – The completeness of the LTO scope for non-safety classified components is not yet verified by the plant.
  – The guidelines for SSC scoping do not cover all relevant hazards which need to be considered and a specific guidance on how to perform scoping of non-safety SSCs due to potential internal flooding of safety SSCs at the plant is not in place.
  – The results of scoping are spread across different documents.
  – There is no unique list or database of SSCs which differentiates between SSCs that are in the scope and out of the scope of LTO program.

  SSR-2/2 Rev.1
  Requirement 16: Where applicable, the operating organization shall establish and implement a comprehensive programme for ensuring the long-term safe operation of the plant beyond a time-frame established in the licence conditions, design limits, safety standards and/or regulations.

  4.54. The comprehensive programme for long term operation shall address:
  […]
  (b) Setting the scope for all structures, systems and components important to safety;
  […]

2.12.3. Review of ageing management and ageing management programmes and revalidation of time limited ageing analysis

- Findings: 2 recommendations, 3 suggestions, 3 good practices
- Common finding: In a few plants, the review of ageing management programmes and revalidation of Time Limited Ageing Analysis (TLAAs) for structures and components within the scope for LTO is not completed. (2/8)

  Examples show:

  – Several paragraphs related to LTO activities, such as the assessment of ageing management and TLAAs, are missing in the Periodic Safety Review (PSR).
  – A systematic review of the design basis documentation to identify all relevant (and plant specific) TLAAs is missing.
  – There is no planning or framework for the systematic review of the results of TLAAs revalidation for possible modifications to plant operating limits and conditions.
  – There is no procedure or process for TLAAs revalidation yet.
  – The time frame for TLAA revalidation and periodicity of TLAA revalidation is not decided yet.

SSR-2/2 Rev.1
4.54. The comprehensive programme for long term operation shall address:
[…]
(d) Revalidation of safety analyses made on the basis of time limited assumptions;
(e) Review of ageing management programmes in accordance with national regulations;
[…]

- Other issues are:
  - Insufficient progress of completing the required technical assessments that support the intended period of operation as planned.
  - Not using of a proactive approach for the identification of technological obsolescence issues.
  - Not aligned and not comprehensive set of condition monitoring and operability assurance programmes.
- Good practices are:
  - Piping and Component analysis and monitoring system that supports all activities of Class I piping fatigue analyses revalidation in an effective manner.
  - Installation of temperature monitors to provide supplemental location-specific data to demonstrate Environmental Qualification compliance for resolution of issues identified during the review of Ageing Management Programmes and Time Limited Ageing Analyses.
  - Automatic calculation of the Local Leak Rate Tests parameters and the global containment leak rates within the plant information system.

2.12.4. Use of PSR and OEF

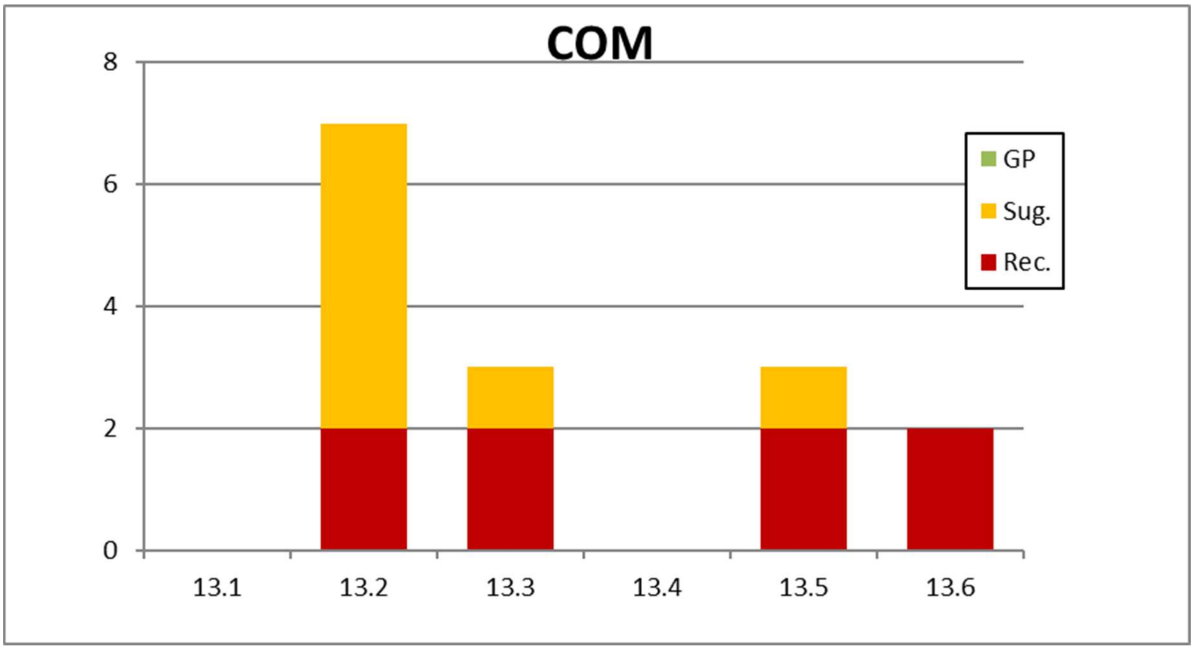
- No finding

2.13. Commissioning

2.13.0. Summary of findings

The review of the COM area in the 3 visited NPPs resulted in 15 findings from which there are 8 recommendations, 7 suggestions and 0 good practice. The distribution of the findings between the different topics of the COM review is presented below:

	Title	Rec.	Sug.	GP	Total
13.1	The commissioning process	0	0	0	0
13.2	Organization and management of commissioning	2	5	0	7
13.3	Implementation of the commissioning programme	2	1	0	3
13.4	Documentation for commissioning	0	0	0	0
13.5	Control of plant configuration	2	1	0	3
13.6	Use of OEF	2	0	0	2
	Total	8	7	0	15



2.13.1. The commissioning process

- No finding

2.13.2. Organization and management of commissioning

- Findings: 2 recommendations, 5 suggestions, 0 good practices
- Common finding: In all plants, the meeting of commissioning milestones without compromising safety is challenging. (3/3, including 2 issues from paragraph 2.3.1 in OPS).

Examples show:

- Schedules for plant systems testing, handover checks and final system line-ups lack the details required to effectively manage the transition of systems from commissioning to operations.
- Provisions and practices for the practical preparedness of operations personnel are not adequate and effective to ensure their sufficient competence for the first core load.
- The plant arrangements for implementation of SAMGs are not adequate to ensure that they are verified, validated, and personnel are trained in their use before fuel loading.
- Main Control Room document availability does not fully support the anticipated fuel load and operating programme.
- Evaluation of the aggregated effect of existing and emergent issues on safety related commissioning activities does not ensure adequate consideration of the impact on all involved groups.
- The effectiveness of the supplier's and plant's project control activities, aggregate risk management and decision making are not sufficient to appropriately manage the fuel loading milestone.

SSR-2/2 Rev.1
6.9. […] Verification and validation of procedures shall be performed to confirm their applicability and quality, and to the extent possible shall be performed prior to fuel handling operations on the site. This process shall continue during the commissioning phase. Verification and validation shall also be carried out for procedures for overall operation.

6.11. Initial fuel loading shall not be authorized until all relevant pre-operational tests have been performed and the results have been accepted by the operating organization and the regulatory body. Reactor criticality and initial power increase shall not be authorized until all necessary tests have been performed and the results have been accepted by the operating organization and the regulatory body, as appropriate. The tests of the commissioning programme shall be successfully completed as a necessary condition for authorization, as appropriate, for normal operation of the plant to be commenced.

SSG-28
3.57. The operating organization should have a process in place for planning human resources to ensure the adequacy of the organization during commissioning. This includes planning of the organization and raising the competence of the staff during commissioning. Adequacy of organization and staff competence should be assessed on a continuous basis.

- <u>Common finding: In many plants, the personnel do not demonstrate ownership for equipment and commitment for staff protection in all areas and commissioning stages. (2/3, including 1 issue from paragraph 2.13.5.)</u>

Examples show:

- The plant standards are not consistently applied in construction, commissioning and operational phases.
- The responsibility for ensuring the protection and preservation of safety related equipment and its environment is not clearly communicated and exercised in all commissioning stages.
- The plant preparedness for emergencies during commissioning is not adequate to ensure safe and effective evacuation of the site.

SSR-2/2 Rev.1
6.14. During construction and commissioning, the plant shall be monitored, preserved and maintained so as to protect plant equipment, to support the testing stage and to maintain consistency with the safety analysis report.

SSG-28
3.17. The management system should ensure that the responsibilities remain clear at all times, even if construction, commissioning and operating activities overlap.

3.22. The responsibilities of the operating organization should include the following:
- To control, review and coordinate the activities of the construction, commissioning and operating groups in an effective manner;
- To ensure that the activities of the construction and commissioning groups are properly managed, and that any issues are dealt with to meet the requirements for safety; […]

2.13.3. Implementation of the commissioning programme

- Findings: 2 recommendations, 1 suggestion, 0 good practices
- <u>Common finding: In many plants, equipment is not appropriately protected during commissioning stage. (2/3)</u>

  Examples show:

- The Foreign Material Exclusion programme is not effectively implemented during the commissioning phase.
- Weaknesses in the execution of the plant commissioning processes:
  - Clear plastic inside Spent Fuel Pool (SFP) FME area,
  - The SFP compartment was neglected in the scope of the corresponding plant FME procedure,
  - The plastic curtains were installed on the SFP doors as a temporary measure. The work was done based on site instructions without referring to FME requirements,
    - A review of the plant operating experience database has shown that weaknesses in the implementation of plant commissioning have re-occurring nature.
- The arrangements to mitigate risks related to fire are not fully implemented.

SSR-2/2 Rev.1
6.14. During construction and commissioning, the plant shall be monitored, preserved and maintained so as to protect plant equipment, to support the testing stage and to maintain consistency with the safety analysis report.

2.13.4. Documentation for commissioning

- No finding

2.13.5. Control of plant configuration

- Findings: 2 recommendations, 1 suggestion, 0 good practices
- <u>Common finding: In many plants, configuration changes are not properly controlled. (2/3)</u>

Examples show:

- Design changes during the construction and commissioning phase are not reflected in operating or maintenance procedures and training.
- The arrangements for control of temporary modifications are not consistently applied to ensure that plant equipment and worker safety is not adversely affected. Some temporary modifications implemented without following the plant process.

SSR-2/2 Rev.1
6.15. During construction and commissioning, a comparison shall be carried out between the as built plant and its design parameters. A comprehensive process shall be established to address non-conformances in design, manufacturing, construction and operation. Resolutions to correct differences from the initial design and non-conformances shall be documented.

SSG-28
4.74. Unavoidable temporary modifications that interfere with the intended design configuration should be properly controlled. An appropriate review should be performed to ensure that safety implications are properly considered.

- The other issue is supporting the common finding in paragraph 2.13.2.:
  - Plant operations do not always have full control of the status of the plant systems and components related to safety.

2.13.6. Use of OEF

- Findings: 2 recommendations, 0 suggestions, 0 good practices
- <u>Common finding: In many plants experience feedback process does not prevent reccurence of events. (2/3)</u>

Examples show:

- Not all events are reported.
- The process for screening of operating experience (OE) is not fully implemented.
- The process of events analysis is simplified and does not encompass all required aspects. The scope of analyzed events is limited.
- The coding system is not used for deviations and subsequently coding based trending is not performed.
- Personnel involved in OE feedback process are not properly qualified and experienced.
- Arrangements to exchange feedback with other plants in construction and commissioning stages could be improved.

SSR-2/2 Rev.1
Requirement 24: The operating organization shall establish an operating experience programme to learn from events at the plant and events in the nuclear industry and other industries worldwide.

SSG-28
3.68. The commissioning stage yields much information that should be taken into account in the subsequent operation of the plant. Proper systems should be established for the reporting and analysis of abnormal events, human errors and 'near misses' that occur in the

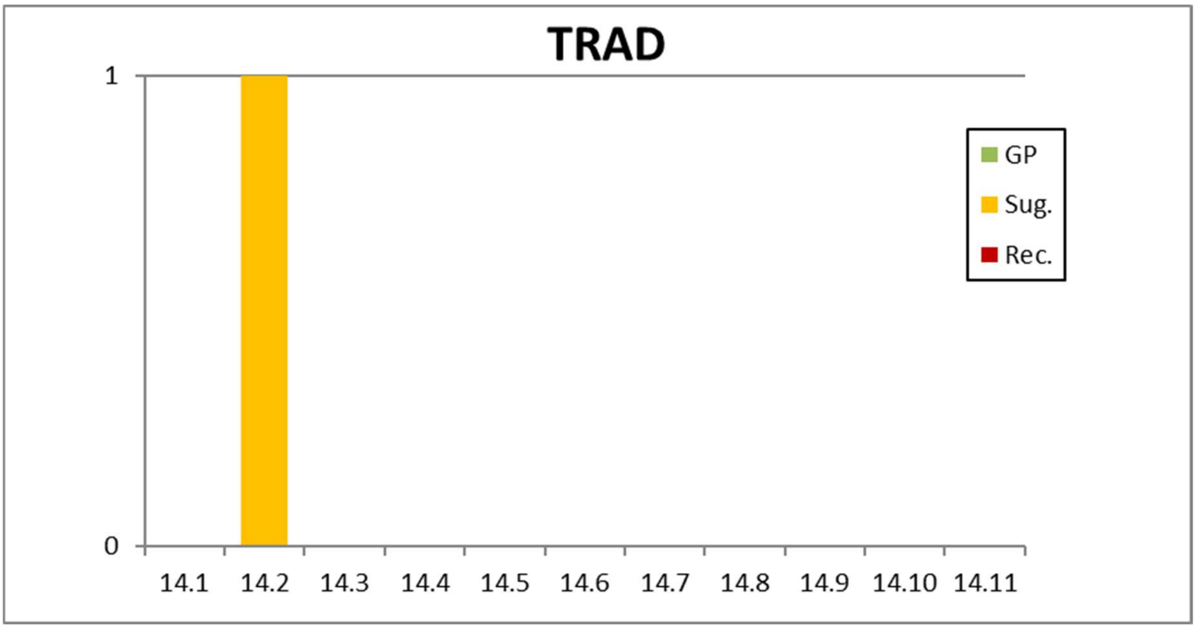
commissioning stage. Experience gained at this stage should be fed back into the training programmes for operating personnel and commissioning personnel. The lessons to be learned should be used in the improvement and development of the commissioning programme, in operating procedures and instructions, and in maintaining configuration control of the simulator and training materials. Available information on operating experience, including reportable occurrences at operating power reactors, should be used appropriately in developing and executing the test procedure. Consideration should also be given to the need for any changes to the design and to the related documents.

2.14. Transitional Period from Operation to Decommissioning

2.14.0. Summary of findings

Only 1 OSART mission applied the TRAD area and resulted in 1 finding from which there is 0 recommendations, 1 suggestion and 0 good practices. Therefore, it is not applicable to identify a common finding for the area. The distribution of the findings between the different topics of the TRAD review is presented below:

Title		Rec.	Sug.	GP	Total
14.1	Organization and functions	0	0	0	0
14.2	Management policies and activities	0	1	0	1
14.3	Conduct of operations	0	0	0	0
14.4	Work management and housekeeping	0	0	0	0
14.5	Technical support activities for the transitional period	0	0	0	0
14.6	Special safety assessments and risk analyses required	0	0	0	0
14.7	Use of operational experience	0	0	0	0
14.8	Radiation protection requirements for the transitional period	0	0	0	0
14.9	Emergency preparedness and response	0	0	0	0
14.10	Core management and fuel handling	0	0	0	0
14.11	Chemistry	0	0	0	0
	Total	0	1	0	1



2.14.1. Organization and functions

- No finding

2.14.2. Management policies and activities

- Finding: 0 recommendations, 1 suggestion, 0 good practices
- No common finding

- The issue is:
  - The inconsistency in Preliminary Decommissioning Plan and noncompliance with the structure of a standard decommissioning plan.

2.14.3. Conduct of operations

- No finding

2.14.4. Work management and housekeeping

- No finding

2.14.5. Technical support activities for the transitional period

- No finding

2.14.6. Special safety assessments and risk analyses required

- No finding

2.14.7. Use of operational experience

- No finding

2.14.8. Radiation protection requirements for the transitional period

- No finding

2.14.9. Emergency preparedness and response

- No finding

2.14.10. Core management and fuel handling

- No finding

2.14.11. Chemistry

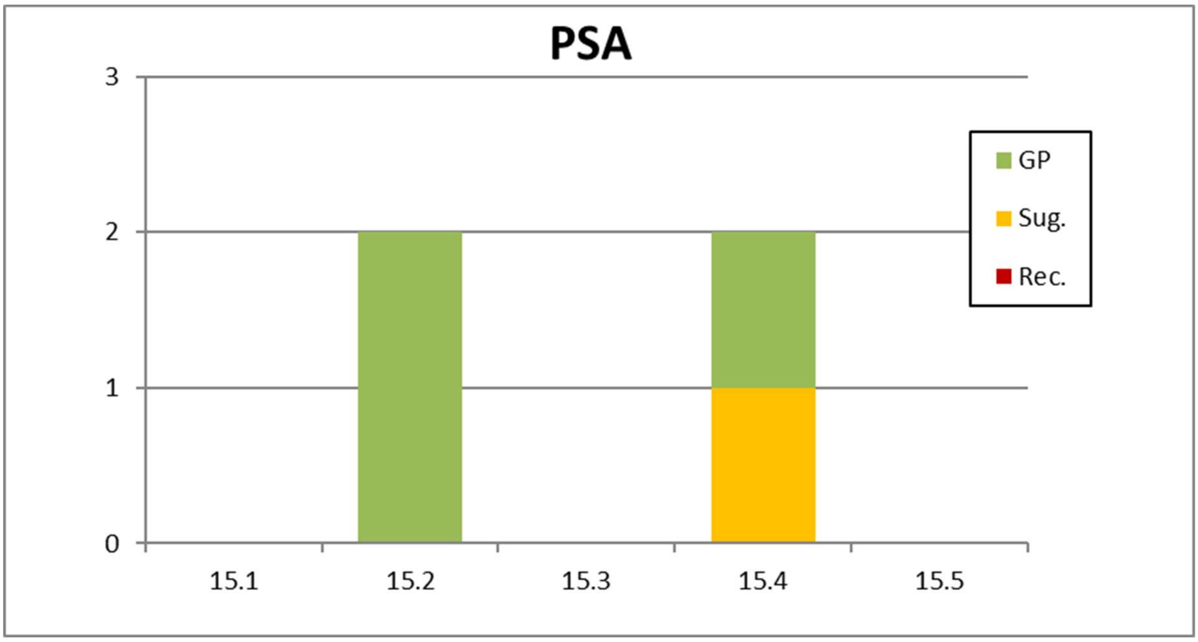
- No finding

2.15. Use of PSA for Plant Operational Safety Improvements

2.15.0. Summary of findings

The review of the PSA area in the 2 visited NPPs resulted in 4 finding from which there are 0 recommendations, 1 suggestion and 3 good practices. The distribution of the findings between the different topics of the PSA review is presented below:

Title		Rec.	Sug.	GP	Total
15.1	Organization and functions	0	0	0	0
15.2	PSA project management	0	0	2	2
15.3	Development of PSA	0	0	0	0
15.4	Use of PSA in PSA applications	0	1	1	2
15.5	Use of PSR and OEF	0	0	0	0
	Total	0	1	3	4



2.15.1. Organization and functions

- No finding

2.15.2. PSA project management

- Findings: 0 recommendations, 0 suggestions, 2 good practices
- No common finding
- Good practices are:
  - The plant comprehensive PSA models that are made accessible to the regulator in a timely manner allowing for good risk-informed communication between the licensee and the regulator.
  - Raising the awareness of plant staff on insights from PSA through systematic training on PSA methodology and wide communication of PSA results.

2.15.3. Development of PSA

- No finding

2.15.4. Use of PSA in PSA applications

- Findings: 0 recommendations, 1 suggestion, 1 good practice
- No common finding
- The issue is:
  - The plant procedures and practices, which are deployed to carry out some PSA tasks/applications (e.g. modelling new systems) and to conduct independent PSA reviews, that do not always ensure effective modelling and documenting of technical analyses within the PSA programme to ensure its consistency.
- The good practice is:
  - The established a PSA group consisting of experienced PSA experts that has full support of the plant management and provides services for the extensive use of PSA applications for continuous safety improvements which includes:
    - Setting internal probabilistic safety targets,
    - Supporting plant outages is by an hour-by-hour calculation of the shutdown PSA model considering the planned maintenance activities and system configurations,
    - Supporting safety-related decision-making,
    - Supporting simulator training of the personnel using the PSA results to determine the safety-critical operator actions.

2.15.5. Use of PSR and OEF

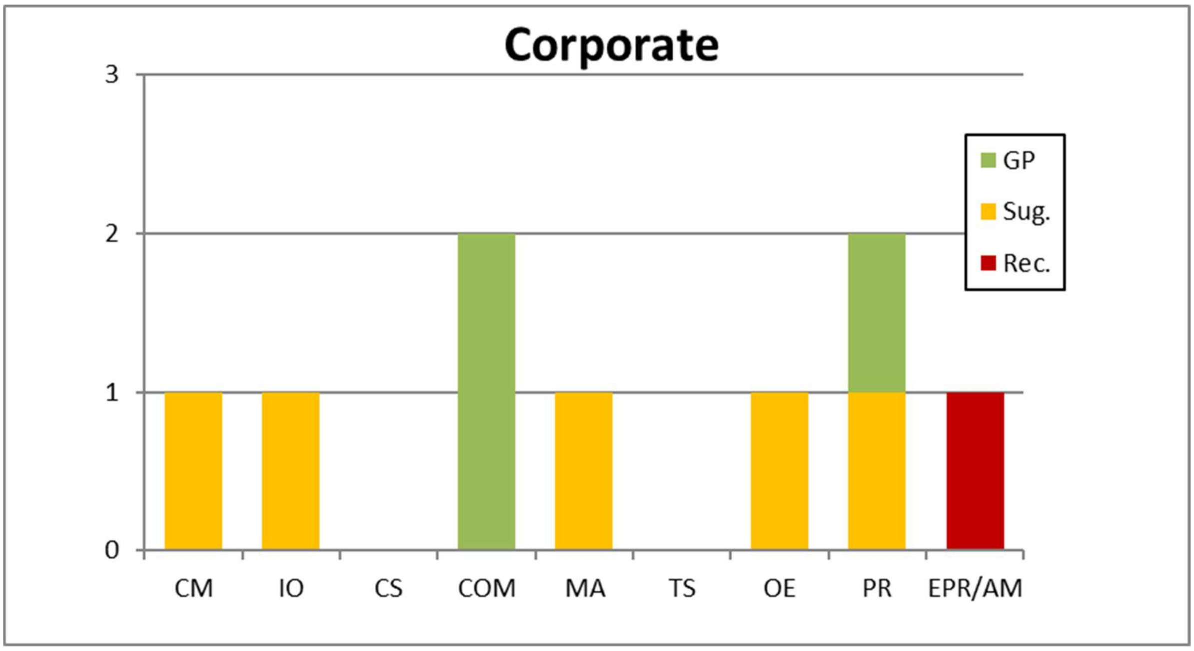
- No finding

2.16. Corporate OSART

2.16.0. Summary of findings

Only 1 Corporate OSART mission was conducted and resulted in 9 findings from which there are 1 recommendation, 5 suggestions and 3 good practices. Therefore, they are not evaluated for common findings. The distribution of the findings between the different topics of the corporate review is presented below:

Title		Rec.	Sug.	GP	Total
16.1	Corporate management	0	1	0	1
16.2	Independent oversight	0	1	0	1
16.3	Corporate support to provide human resources	0	0	0	0
16.4	Organization interactions and communication	0	0	2	2
16.5	Maintenance	0	1	0	1
16.6	Technical support	0	0	0	0
16.7	Operating experience feedback	0	1	0	1
16.8	Procurement	0	1	1	2
16.9	Accident management & Emergency preparedness and responses	1	0	0	1
	Total	1	5	3	9



2.16.1. Corporate management

- Finding: 0 recommendations, 1 suggestion, 0 good practices
- No common finding
- The issue is:
  - The leadership approaches to challenging current performance and reinforcing management expectations are not always effective in preventing significant events and continuously improving safety.

2.16.2. Independent oversight

- Finding: 0 recommendations, 1 suggestion, 0 good practices
- No common finding
- The issue is:
  - The corporate independent oversight functions do not always challenge and provide a critical view of current fleet performance to ensure timely identification of some performance gaps.

2.16.3. Corporate support to provide human resources

- No finding

2.16.4. Organization interactions and communication

- Findings: 0 recommendations, 0 suggestions, 2 good practices
- No common finding
- Good practices are:
  - Using a computer-based information simulator to develop and train the skills of the communication personnel and journalists to inform the public in the event of a severe accident at a nuclear power plants as well as other potential crisis situations.
  - By having 11 profiles, including a YouTube channel, VK account, Twitter account and Facebook profile, the company has achieved a great success through social networks, and really uses them for communication in emergency situations, to prevent panic among the society.

2.16.5. Maintenance

- Finding: 0 recommendations, 1 suggestion, 0 good practices
- No common finding
- The issue is:
  - The organization's maintenance indicators do not cover all activities related to effective implementation of maintenance requirements.

2.16.6. Technical support

- No finding

2.16.7. Operating experience feedback

- Finding: 0 recommendations, 1 suggestion, 0 good practices
- No common finding
- The issue is:
  - Some of the arrangements related to the Operating Experience Feedback process are not always implemented sufficiently to ensure prevention of event recurrence, timely addressing adverse trends, gaps in performance and safety improvement.

2.16.8. Procurement

- Findings: 0 recommendations, 1 suggestion, 1 good practice
- No common finding
- The issue is:
  - Some elements of the process for the procurement of nuclear related products and services have not been fully integrated and monitored to ensure that nuclear safety is not compromised.
- The good practice is:
  - Optimizing resources, focusing on nuclear safety related activities. Upon collecting all the requirements of all REA entities and corporate approval, the procurement plan for the next year is published on the web site by 30 September of the current year. The plan contains all planned procurements, basic technical requirements, initial maximum price and the time schedule of publishing the tenders and is public.

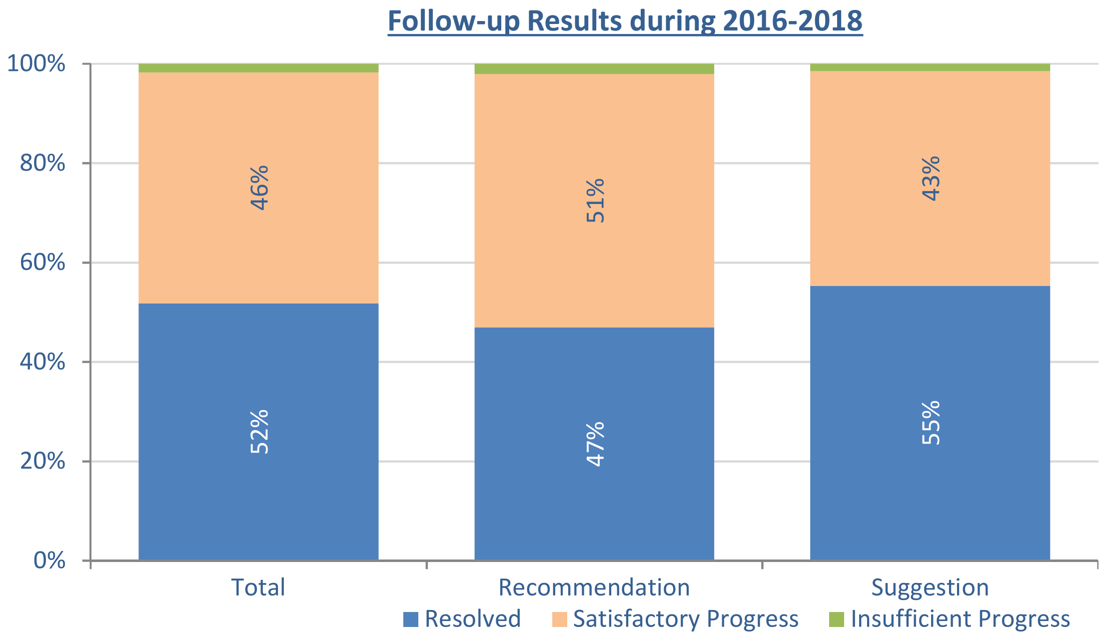
2.16.9. Accident management & Emergency preparedness and response

- Finding: 1 recommendation, 0 suggestions, 0 good practices
- No common finding
- The issue is:
  - Some aspects of the Severe Accident Management (SAM) programme have not been fully implemented to ensure prevention, or mitigation of the consequences of severe accidents.

2.17. OSART at the follow-up visit

OSART follow-up visits are conducted as an integral part of the OSART process, approximately 18 months to two years after the main OSART mission. From 2016 to 2018, 14 follow-up visits listed below were conducted:

Plant	Country	Year
Kola	Russian Federation	2016
Paks	Hungary	
EDF corporate	France	
Flamanville 1 & 2	France	
Borssele (1st stage)	Netherlands	
Dampierre	France	2017
Sizewell B	UK	
Novovoronezh	Russian Federation	
Bruce B	Canada	
Kashiwazaki 6 & 7	Japan	
Borssele (2nd stage)	Netherlands	
Chashma 1	Pakistan	
Pickering	Canada	2018
Krsko	Slovenia	



As shown in the figure above, during this period, 98% of the issues (recommendations and suggestions) were either totally resolved or satisfactory progress was made. Only 2% of the issues were concluded as having ‘insufficient progress’. Among 228 issues, 0 issues were withdrawn.

Slightly fewer recommendations were resolved or in satisfactory progress than suggestions. This can reasonably be expected because recommendations are generally more significant and can take longer to resolve.

Nevertheless, these results of the follow-up visits demonstrated the effectiveness of the OSART service and the commitment of the plants to implement improvements identified by OSART teams.

3. ASSESSMENT OF OVERALL OSART MISSION RESULTS

3.1. Feature of findings

3.1.1. Findings in each review area

The table below shows the numbers of findings in each standard review area:

	LMS	TQ	OPS	MA	TS	OEF	RP	CH	EPR	AM	HTO	LTO	COM	TRAD	PSA	Total
Issues	**33**	**11**	**34**	**21**	**17**	**19**	**22**	**22**	**22**	**12**	**8**	**10**	**15**	**1**	**1**	**248**
(Rec.)	18	6	15	12	6	12	8	6	6	4	2	3	8	0	0	106
(Sug.)	15	5	19	9	11	7	14	16	16	8	6	7	7	1	1	142
Good Practices	**4**	**9**	**12**	**6**	**8**	**1**	**10**	**7**	**6**	**8**	**3**	**5**	**0**	**0**	**3**	**82**
Applied Missions	15	15	15	15	15	15	15	15	14	15	11	8	3	1	2	-

This table indicates some characteristic features:

– The number of issues and recommendations per mission are high in LMS area and OPS area: more than 2 issues, including 1 recommendation, are identified in average.

  The reason on LMS area seems to be that many findings identified on various areas had been discussed by the OSART review team in resulting to develop issues on industrial safety policy or management expectations.

  Regarding the OPS area, the reason is that the review scope is wider than other areas, which assigns two reviewers and counterparts.

– The number of issues per mission is the lowest in TQ area, and 9 GPs are identified.

  This tendency has been the same since the previous three years (2013-2015). That indicates that plants' practices are more in-line with requirements of safety standards in TQ area than in other areas, by improvement utilizing the good practices provided past OSART missions.

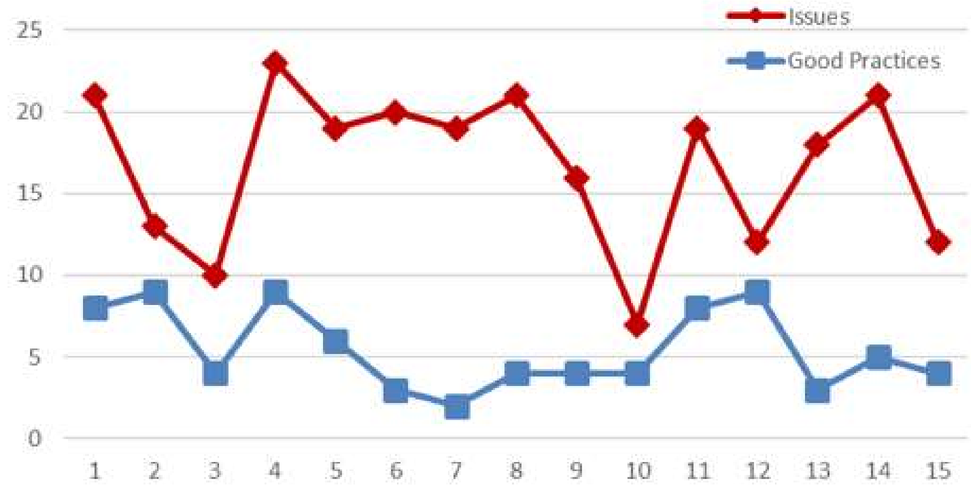
– More than half issues are recommendations on LMS, MA, OEF and COM area.

  That indicates that the OSART teams identified the significant fundamental overall problems from the gaps between plants' practices and the requirements of safety standards.

  In addition, the number of good practices on OEF area and COM area are very few (OEF: 1, COM: 0). That might also indicate that plants' more proactive attitude is necessary to improve the operational safety on those areas.

3.1.2. Correlation of findings

The figure below summarizes the numbers of findings in each OSART mission (red for the sum of the recommendations and suggestions and blue for the good practices):



Correlation of findings (Issues vs Good practices)

It shows the same tendency as the previous OSART highlights (2013-2015) that the number of issues and good practices are negatively correlated, i.e. wherever the number of issues is high, the number of good practices is low and vice versa. It might be a proof that whole aspects of the plant are appropriately grasped in each mission based on the IAEA safety standards.

3.2. References used in the reports

3.2.1. Frequency of references to main safety requirements and safety guides

The table below shows the numbers of times referenced of main safety requirements and safety guides in 16 missions:

Safety requirements or guides	Number of times referenced
GSR Part 2; Leadership and Management for Safety	30
GS-G-3.1; Application of the Management System for Facilities and Activities	30
GS-G-3.5; The Management System for Nuclear Installations	16
GSR Part 3; Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards	19
RS-G-1.1; Occupational Radiation Protection	8
RS-G-1.3; Assessment of Occupational Exposure Due to External Sources of Radiation	2
RS-G-1.8; Environmental and Source Monitoring for Purposes of Radiation Protection	1
GSR Part 4 Rev.1; Safety Assessment for Facilities and Activities	2
SSG-3; Development and Application of Level 1 Probabilistic Safety Assessment for Nuclear Power Plants	1
SSR-2/2 Rev.1; Safety of Nuclear Power Plants: Commissioning and Operation	244
NS-G-2.1; Fire Safety in the Operation of Nuclear Power Plants	9
NS-G-2.2; Operational Limits and Conditions and Operating Procedures for Nuclear Power Plants	2
NS-G-2.3; Modifications to Nuclear Power Plants	4
NS-G-2.4; The Operating Organization for Nuclear Power Plants	35
NS-G-2.5; Core Management and Fuel Handling for Nuclear Power Plants	5
NS-G-2.6; Maintenance, Surveillance and In-service Inspection in Nuclear Power Plants	22
NS-G-2.7; Radiation Protection and Radioactive Waste Management in the Operation of Nuclear Power Plants	18
NS-G-2.8; Recruitment, Qualification and Training of Personnel for Nuclear Power Plants	20
NS-G-2.11; A System for the Feedback of Experience from Events in Nuclear Installations	23
NS-G-2.12; Ageing Management for Nuclear Power Plants	7
NS-G-2.13; Evaluation of Seismic Safety for Existing Nuclear Installations	4
NS-G-2.14; Conduct of Operations at Nuclear Power Plants	43
NS-G-2.15; Severe Accident Management Programmes for Nuclear Power Plants	14
SSG-13; Chemistry Programme for Water Cooled Nuclear Power Plants	22
SSG-25; Periodic Safety Review for Nuclear Power Plants	5
SSG-28; Commissioning for Nuclear Power Plants	14
GSR Part 7; Preparedness and Response for a Nuclear or Radiological Emergency	24
GS-G-2.1; Arrangement for Preparedness for a Nuclear or Radiological Emergency	5
WS-G-2.1; Decommissioning of Nuclear Power Plants and Research Reactors	1

3.2.2. Frequency of references to each requirement in SSR-2/2 Rev.1

The table below shows the numbers of times referenced of each requirement in SSR-2/2 Rev.1, in 15 missions. The most characteristic feature is that Requirement 24 Feedback of operating experience. The reason is thought to be that the corrective action programme (CAP) and its effective use are essential part for almost all plant activities to prevent unexpected events and improve the plant safety. Therefore Requirement 24 had been referred on not only the OEF area but on other areas.

Requirements in SSR-2/2 Rev.1	Number of times referenced
1: Responsibilities of the operating organization	7
2: Management system	6
3: Structure and functions of the operating organization	1
4: Staffing of the operating organization	6
5: Safety policy	6
6: Operational limits and conditions	2
7: Qualification and training of personnel	11
8: Performance of safety related activities	13
9: Monitoring and review of safety performance	18
10: Control of plant configuration	6
11: Management of modifications	5
12: Periodic safety review	3
13: Equipment qualification	4
14: Ageing management	5
15: Records and reports	1
16: Programme for long term operation	9
17: Consideration of objectives of nuclear security in safety programmes	0
18: Emergency preparedness	15
19: Accident management programme	10
20: Radiation protection	4
21: Management of radioactive waste	1
22: Fire safety	8
23: Non-radiation-related safety	6
24: Feedback of operating experience	25
25: Commissioning programme	6
26: Operating procedures	7
27: Operation control rooms and control equipment	2
28: Material conditions and housekeeping	24
29: Chemistry programme	11
30: Core management and fuel handling	2
31: Maintenance, testing, surveillance and inspection programmes	20
32: Outage management	0
33: Preparation for decommissioning	0

CONTRIBUTORS TO DRAFTING AND REVIEW

Drafting Consultancy Meeting, Vienna, Austria, 9-13 September 2019:

LEMAY Francois
International Safety Research, Inc.
38 Colonnade Road North
Ottawa, Ontario k2e 7j6, Canada

LIPAR Miroslav
Ruzova Dolina 806
91901 Sucha Nad Parnou, Slovakia

MALKHASYAN Hakob
Worley Parsons NS
85-87 Todor Alexandrov Blvd.
1303 Sofia, Bulgaria

NOEL Marc
EC Joint Research Centre
Kogendijk 5 1862XA BERGEN, Belgium

TARARIN Aleksei
21-35, Molodezhnaya street
188542 SOSNOVY BOR, Russian Federation

CAVELLEC Ronan
IAEA - Scientific secretary
Division of Nuclear Installation Safety and Security

SUGAHARA Jun
IAEA - Scientific secretary
Division of Nuclear Installation Safety and Security

Reviewers:

TARREN Peter
IAEA - Expert
Division of Nuclear Installation Safety and Security

MARTYNENKO Yury
IAEA - Expert
Division of Nuclear Installation Safety and Security

BILIC ZABRIC Tea
IAEA - Expert
Division of Nuclear Installation Safety and Security

JIANG Fuming
IAEA - Expert
Division of Nuclear Installation Safety and Security

MORGAN Simon
IAEA - Expert
Division of Nuclear Installation Safety and Security