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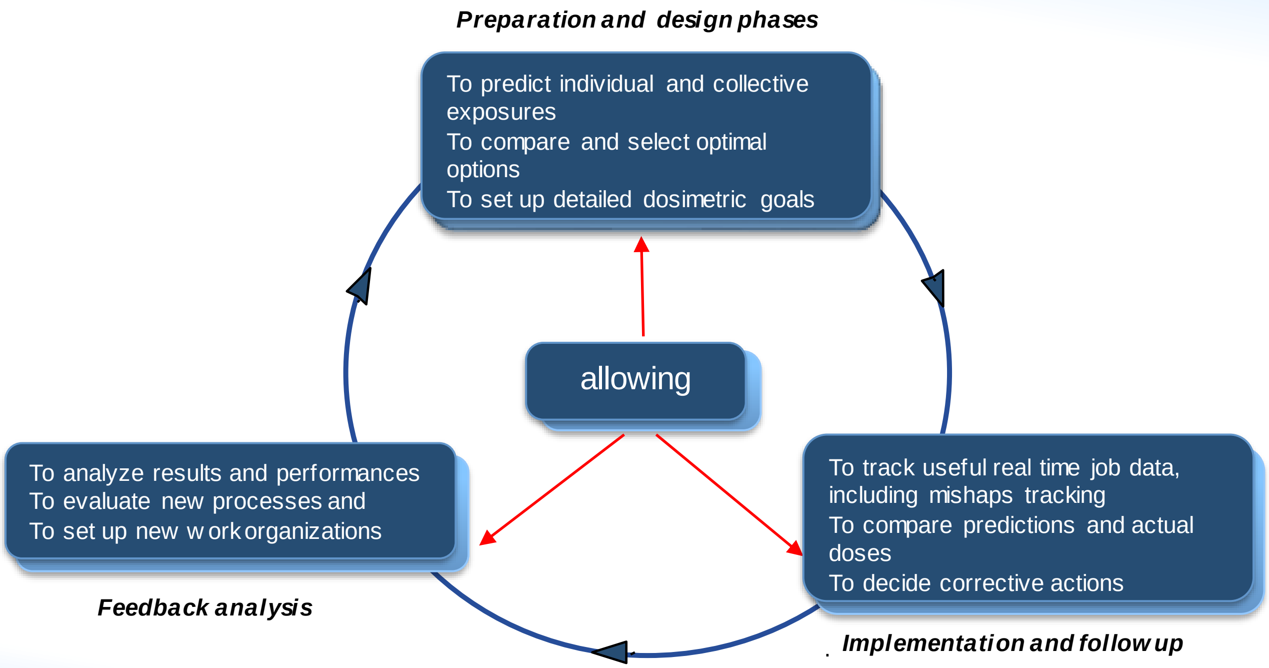
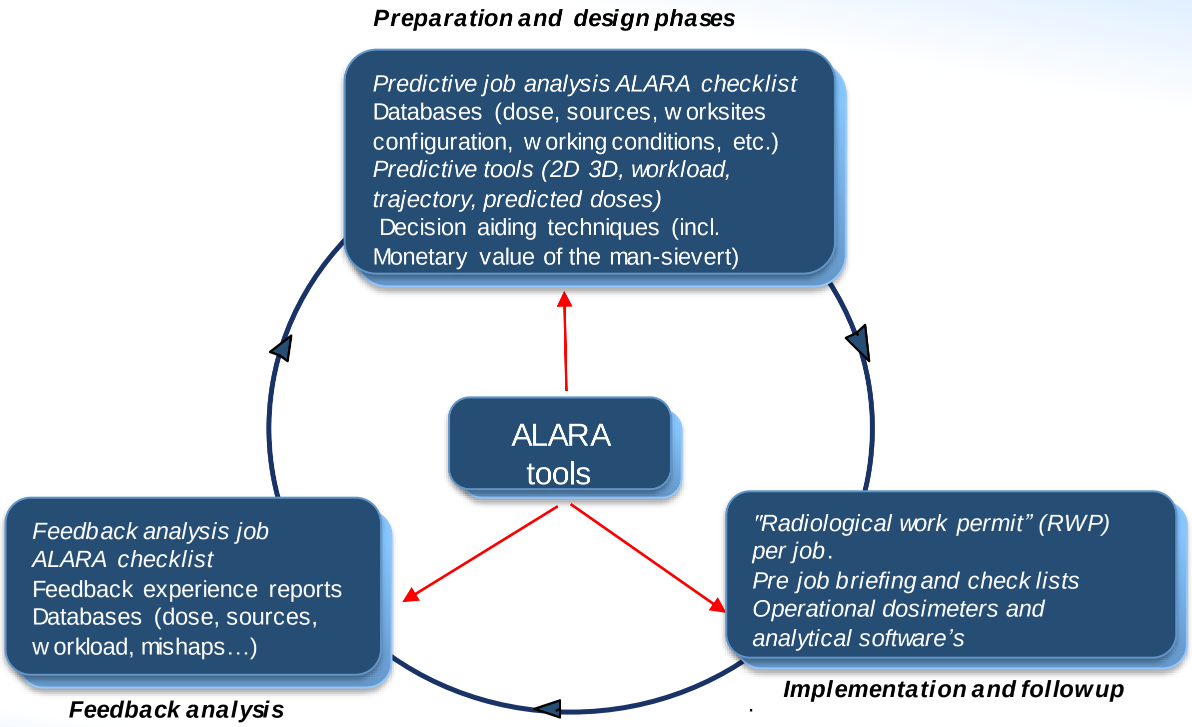
11.3 The ALARA programme : adapted tools

Adapted tools allowing :



Examples of ALARA tools



1. Preparation and design phases
Reminding: The first questions to be addressed

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What are the most costly areas in terms of occupational doses?

What are the higher task related doses?

Or what are the specialties most exposed?

What are the workers the most exposed?

Answering to these questions always implies implementing an analytical approach, making use of feedback databases and/or predictive tools

Predictive tools for estimating doses

Quite a lot of sophisticated tools are devoted to dose rate measurements as an input for dose calculation

- Many traditional portable dose rate meters
- And more recently developed
- Portable gamma camera
- Portable spectroscopy;

When measurements are not possible or not enough, some others are devoted to dose rates modelling (see CS3-SGR and CS4-BR3 case study)

- Microshield
- More complex 3D software's
- CHAVIR at CEA in France
- ERGODOSE at NNC in the UK
- VRDOSE at IFE HALDEN in Norway
- VR-domain at Rolls Royce in the UK
- Virtual radiation field, University of Florida, USA
- …

Very few integrate dose rate assessed through modelling, dose rates measured, and workload per task to assess doses

One of them, VISIPLAN, have been presented within the BR3 case study

Predictive tools for estimating doses

portable dose rate meters

Portable gamma camera

Portable spectroscopy;

Envisaging all possible options

To envisage all possible options during preparation brain storming phase, check lists are available for engineers and planners

	Yes	No	To be studied	Comments and actions
Is there previous experience on similar operation?				
Has it been taken into account?				
Is this an essential task?				
I Action on source				
Is a decontamination possible?				
Is it possible to maintain water in circuits?				
Is it possible to take off highly irradiating material?				
Other?				
II Shielding				
Against external exposure				
Is it possible to install fixed shielding?				
Is it possible to install mobile shielding?				
Is it possible to integrate shielding to the machinary?				
Against contamination				
Is a glove box available?				
Is it possible to put a hopper?				
Is it possible to integrate shielding with the tools?				
Static containment?				
Dynamic containment?				
Sprinkling and drainage?				
Adapted individual protection available?				
…				

Should check lists focus only on dose rates reduction actions?

Of course what is easiest for the Health Physics is to assess sources and dose rate reduction

However reminding that : $S = k \times d \times t \times N$

where

- S is the collective dose
- d is the dose rate
- t is the duration of exposure
- N is the number of exposed workers
- k is the exposure coefficient

Many actions may be focus on the reduction of other factors than reducing “d”

There is an evidence that a global work management approach must be adopted considering all the factors

One should then try to act on all these factors through a global work management approach

Envisaging all possible options

So to envisage all possible options during preparation brainstorming phase check lists should cover work management

	Yes	No	To be studied	Comments and actions
Volume of work exposed				
Is the procedure optimal?				
Is the task correctly scheduled?				
Are they risks of co activity between different jobs and teams?				
Are they problems of classical safety interfering with radiological protection				
Is the task to be entirely executed in an irradiated zone?				
May some operators be moved to a distance?				
Is number of operators justified?				
Is the distribution of work optimized?				
Can doses be spread between operators?				
Are there special tools for reducing doses?				
Opportunity for remote control or robotics?				
Can clothing be modified to facilitate the work?				
Possible improvement to ambient conditions (temperature, lighting)?				
Possible use of radio communications?				
Opportunity for televisual surveillance?				
Easier access possible?				
Is handling equipment available?				
Adequate superstructures? (e.g. scaffolding,…)				
Are there standing and procurement areas?				
Are there procedures for packing equipment and packaging waste?				
Are there procedures for the removal of material?				
…				
Mishaps				
Have the main potential mishaps being studied?				
Training				
Is there an opportunity of training on mock-ups ?				
…				

Assessing the efficiency of options: Impact of working conditions on the exposed time

Working conditions	Impact on exposed time
Light	**+ 20 %** if lighting of work
Audio links	**+ 20 %** in case of absence of audio link for jobs where workers are distant one from another
Working space: **Not very congested area**	**+ 20 %** in comparison with a situation with open area
Working space: **Highly congested area**	**+ 40 %** in comparison with a situation with open area

Assessing the efficiency of options: the coefficient of exposure "k"

Is often presented as s = d x t

In reality when you know the actual dose s'
The actual work time t' and actual dose rate d '

You never find

s' ≠ d' x t' in general s' < d' x t' s' = k x d' x t'

With k often equal to 0.7 (feedback from many jobs in the industry)

The worker is never standing the whole time at the same place (the work place with d'), he is moving changing tools, back to the job, …and never "uses" the full dose rate during the whole time

Decision aiding techniques

When only two criteria(costs and doses) are retained for making the decision :

The most well known techniques are the cost efficiency and cost benefit analysis that make use of the man.Sievert monetary value, so called alpha value.

When more criteria have to be taken into account, multicriteria analysis can be performed.

All these (already mentioned in some case studies) will be further presented in the next lecture.

2. Implementation and follow up phases: Radiation Work Permit (RWP)

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This is an essential ALARA tool for the starting of the implementation; it is a result of the preparation phase.

It is mandatory in all nuclear facilities and no job is allowed to start without RWP being provided to team leaders.

It always present a lot of information

- date and time of job
- planned number of workers and names when known
- short description of job
- levels of dose rates and surface and air contaminations
- protective clothing required
- biological shielding required
- special safety measures (fire, release of gases, etc.)
- planned duration of job
- expected dose goals

For the high level risks jobs it also refer to the ALARA analysis, and it provides the main results of that analysis.

Radiological Work Permit (RWP): a French example (generic)

Reference to the radiological risk level

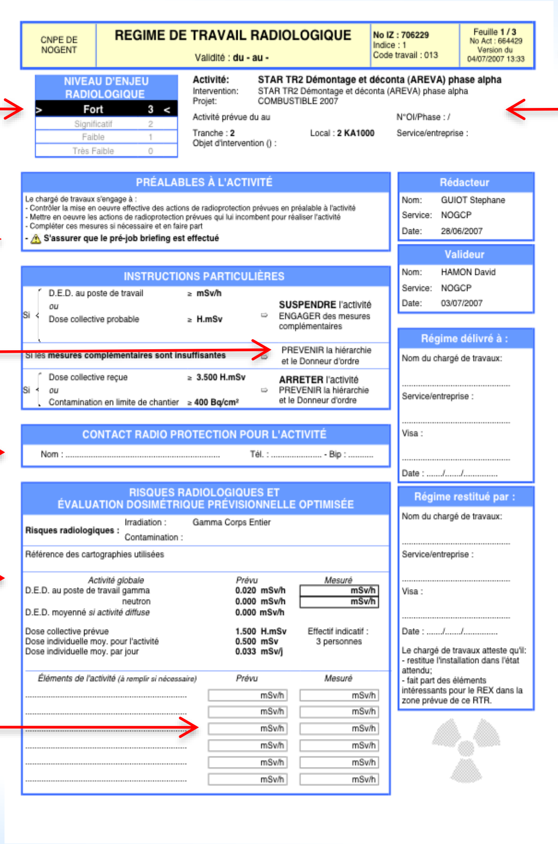
Instructions for actions before the job

Actions if dose rates or collective dose Exceed some specified levels

Radiological protection contact person

Dose rates and doses evaluation

Comparison prediction / follow up



CNPE DE NOGENT

REGIME DE TRAVAIL RADIOLOGIQUE

Validité : **du - au -**

No IZ : 706229
Indice : 1
Code travail : 013

Feuille **1 / 3**
No Act : 664429
Version du 04/07/2007 13:33

NIVEAU D'ENJEU RADIOLOGIQUE

> Fort	3	<
Significatif	2	
Faible	1	
Très Faible	0	

Activité: **STAR TR2 Démontage et déconta (AREVA) phase alpha**
Intervention: STAR TR2 Démontage et déconta (AREVA) phase alpha
Projet: COMBUSTIBLE 2007
Activité prévue du au
N°OI/Phase : /
Tranche : **2**
Local : **2 KA1000**
Service/entreprise :
Objet d'intervention () :

PRÉALABLES À L'ACTIVITÉ

Le chargé de travaux s'engage à :
- Contrôler la mise en oeuvre effective des actions de radioprotection prévues en préalable à l'activité
- Mettre en oeuvre les actions de radioprotection prévues qui lui incombent pour réaliser l'activité
- Compléter ces mesures si nécessaire et en faire part
- ⚠ **S'assurer que le pré-job briefing est effectué**

Rédacteur
Nom: GUIOT Stephane
Service: NOGCP
Date: 28/06/2007

Valideur
Nom: HAMON David
Service: NOGCP
Date: 03/07/2007

INSTRUCTIONS PARTICULIÈRES

Si { D.E.D. au poste de travail ≥ **mSv/h** *ou* Dose collective probable ≥ **H.mSv** } ⇨ **SUSPENDRE** l'activité ENGAGER des mesures complémentaires

Si les **mesures complémentaires sont insuffisantes** ⇨ PREVENIR la hiérarchie et le Donneur d'ordre

Si { Dose collective reçue ≥ **3.500 H.mSv** *ou* Contamination en limite de chantier ≥ **400 Bq/cm²** } ⇨ **ARRETER** l'activité PREVENIR la hiérarchie et le Donneur d'ordre

Régime délivré à :
Nom du chargé de travaux:
Service/entreprise :
Visa :
Date : ....../......./..............

CONTACT RADIO PROTECTION POUR L'ACTIVITÉ

Nom : .... Tél. : .... - Bip : ....

RISQUES RADIOLOGIQUES ET ÉVALUATION DOSIMÉTRIQUE PRÉVISIONNELLE OPTIMISÉE

Risques radiologiques : Irradiation : Gamma Corps Entier
Contamination :

Référence des cartographies utilisées

Activité globale	*Prévu*	*Mesuré*
D.E.D. au poste de travail gamma	0.020 mSv/h	mSv/h
neutron	0.000 mSv/h	mSv/h
D.E.D. moyenné *si activité diffuse*	0.000 mSv/h	
Dose collective prévue	1.500 H.mSv	Effectif indicatif : 3 personnes
Dose individuelle moy. pour l'activité	0.500 mSv	
Dose individuelle moy. par jour	0.033 mSv/j	

Éléments de l'activité (à remplir si nécessaire)	*Prévu*	*Mesuré*
....	mSv/h	mSv/h
....	mSv/h	mSv/h
....	mSv/h	mSv/h
....	mSv/h	mSv/h
....	mSv/h	mSv/h
....	mSv/h	mSv/h

Régime restitué par :
Nom du chargé de travaux:
Service/entreprise :
Visa :
Date : ....../......./..............

Le chargé de travaux atteste qu'il:
- restitue l'installation dans l'état attendu;
- fait part des éléments intéressants pour le REX dans la zone prévue de ce RTR.

First page

Job definition

Radiological Work Permit (RWP) a French example specific for industrial radiography

Who ask for?

Source characteristics

Use of a collimator

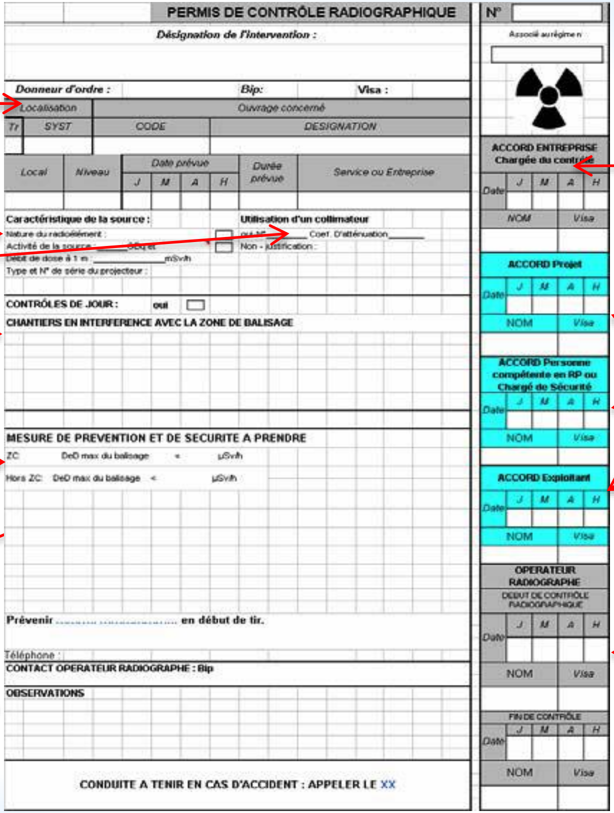
Potential interferences with other works

Radiological protection
Prevention actions

Expected dose rates

Observations

Who to contact in case of accident



PERMIS DE CONTRÔLE RADIOGRAPHIQUE

N°

Désignation de l'intervention :

Associé au régime n°

Donneur d'ordre : *Bip:* **Visa :**

Localisation		*Ouvrage concerné*	
Tr	*SYST*	*CODE*	*DESIGNATION*

Local	*Niveau*	*Date prévue*				*Durée prévue*	*Service ou Entreprise*
		J	*M*	*A*	*H*		

Caractéristique de la source :
Nature du radioélément :
Activité de la source : ______GBq et
Débit de dose à 1 m : ______________mSv/h
Type et N° de série du projecteur :

Utilisation d'un collimateur
oui N°_______ Coef. D'atténuation_______
Non - justification :

CONTRÔLES DE JOUR : oui

CHANTIERS EN INTERFERENCE AVEC LA ZONE DE BALISAGE

MESURE DE PREVENTION ET DE SECURITE A PRENDRE
ZC: DeD max du balisage = µSv/h
Hors ZC: DeD max du balisage < µSv/h

Prévenir .... **en début de tir.**

Téléphone :

CONTACT OPERATEUR RADIOGRAPHE : Bip

OBSERVATIONS

CONDUITE A TENIR EN CAS D'ACCIDENT : APPELER LE XX

ACCORD ENTREPRISE Chargée du contrôle				
Date	*J*	*M*	*A*	*H*
NOM		*Visa*		

ACCORD Projet				
Date	*J*	*M*	*A*	*H*
NOM		*Visa*		

ACCORD Personne compétente en RP ou Chargé de Sécurité				
Date	*J*	*M*	*A*	*H*
NOM		*Visa*		

ACCORD Exploitant				
Date	*J*	*M*	*A*	*H*
NOM		*Visa*		

OPERATEUR RADIOGRAPHE				
DEBUT DE CONTRÔLE RADIOGRAPHIQUE				
Date	*J*	*M*	*A*	*H*
NOM		*Visa*		
FIN DE CONTRÔLE				
Date	*J*	*M*	*A*	*H*
NOM		*Visa*		

Visa from the IR company

Visas from the client

Visas from the radiographer
start of the control

Visas from the radiographer
End of the control

The RWP as a pre requisite

The RWP is being a pre requisite, the next step is the pre job briefing supported by pre-job check list for team leaders.

To hold a briefing session with the team before entering the controlled zone

In the briefing session, to making use in particular of the RWP

To describe the work to be carried out

To describe the place where the work is to be carried out and the best route there in view of the radiological conditions (e.g. locations of hot points)

To describe any environmental constraints liable to complicate the use of tools and execution of the work (space, lighting, scaffolding, biological shielding in place …)

If you lack any of this information, ask the job coordinator and/or the radiological protection worker.

Pre-job check list for team leaders (2)

To indicate:

- the provisional map of dose rates
- the risk of contamination
- the collective protections provided and their locations
- the doses anticipated in performing the work
- the withdrawal place.

To precise the job situation within the planning with regards to previous and following tasks at the same location

To check that your job does not interfere with others

If you lack any of this information, ask the job coordinator and/or the radiological protection worker.

Pre-job check list for workers (1)

Planning

- Do you know exactly what you have to do?
- Do you know the route to your work?
- Have you checked that your work will not interfere with that of others?
- Have you checked your tools before entering the zone?
- Have you checked that no tool is missing and that all are in a proper operating condition?
- Are they adapted to the environment?

If you do not know the answers to any of these questions, ask your team leader or the plant radiological protection worker.

Pre-job check list for workers (2)

Environment

Are you aware of the exposure conditions of the work?

- dose rates?
- risks of contamination?
- positions of the main sources?
- doses expected?

Do you know what collective shielding is planned and how it is to be positioned?

Do you know what respiratory protection equipment you must use?

Do you know where you are to work? Where are the electrical outlets and utility connections?

Do you know what the nearest fallback point is for studying your work procedure sheet or waiting for another job to be completed?

Real time operation follow up (1)

For external exposure,

- The so called passive dosimeters (film badge, TLD) do not allow any analysis, as the film is read after a long period of exposure (one month or more) and TLD after several days.
- It is then impossible to answer “when and how has the dose been undertaken”.
- Active Personal Dosimeters (APD) are then very interesting tools for performing optimisation studies

Real time operation follow up (2)

In Nuclear facilities

- **APD are used everywhere**... but still problem with the task codes
- a major development *data capture on the fly* which allows to spread the dose in different sub-areas

In Medicine, research … and non nuclear industry

- APD are not so frequent
- To **favour worksite generic surveys** for repetitive interventions and to implement optimization studies
- To make use of electronic dosimeters only when the stakes justify it

Real time operation follow up (3)

For internal exposure

- Bioassays and whole body counting can be considered as the equivalent of passive “dosimetry” (see NORM presentation), and not all useful for optimisation
- Therefore the use of adapted personal air sampler for generic surveys will often be the only way to have the adequate data for optimisation studies.

Feedback experience meeting guide sheet

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Task:

Meeting participants:

All the questions must be answered as fully as possible so that the task might be assessed and used as the basic for modifications during future works.

1. Were the tools and equipment required for the operation available at the right time?
2. Was the zone prepared and ready for your task on your arrival?
3. Were the protections suitable for the task executed in this zone?
4. How long did you have to prepare the task? Was this long enough?
5. Did other tasks interfere with yours?
6. Was the work location kept clean and orderly so as to ease your work?
7. Was the full team aware of its exposure? Did you insist on this exposure being limited as much as possible?
8. Was the entire team aware of the site dose targets. Was it motivated?
9. Were there any problems of coordination with other specialties, other departments or other workers?
10. What problems did you meet which could have resulted in higher exposure?

Radiation protection feedback experience report

Should analyze the operation (or the year) in terms of

- Dose results
- Problems
- Solutions implemented

Should develop a prospective evaluation

- Proposing corrective actions, or studies for finding them
  - Developing new tools
  - New work organisation
  - Modifying working conditions
  - Modifying source term

Basis to prepare the next operation (or year)

Conclusions on tools

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All these tools are useful however they often have to be adapted to the specificities of each installation, each organisation

New other tools might be developed in many organisations

Therefore participating to ALARA networks remains very important for spreading the information dealing with these tools