Work Management to Optimise Occupational Radiological Protection at Nuclear Power Plants

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This was presented by C. Schieber at the Third European IRPA Congress in Helsinki, Finland

Introduction

- Presentation of a report published in 2009, updating a previous publication from 1997
- Prepared by the 'Expert Group on Work Management (EGWM) with ISOE members

- **ISOE : Information System on Occupational Exposure**
  - Jointly sponsored by OECD/NEA and IAEA
  - A network of Utilities and Regulatory bodies
    - 65 Participating Utilities in 28 countries
    - Regulatory authorities of 23 countries
  - Management of an international database on occupational exposures at NPPs (472 reactors, among them 396 operating ones)
  - Feed-back experience exchange
  - Regional and international symposia

Expert Group Members

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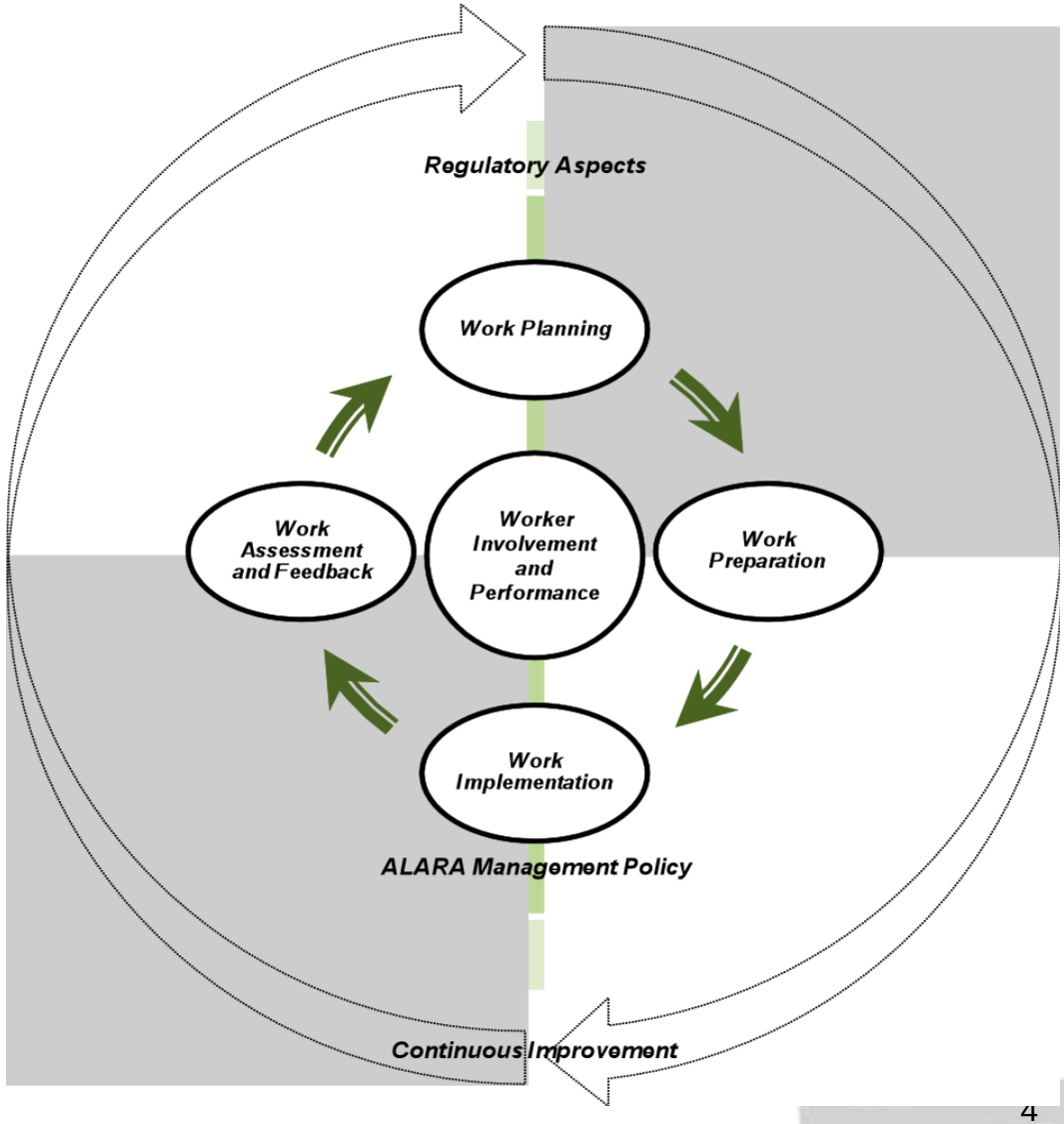
- Mr. V. Simionov Cernavoda NPP, Romania
- Mr. D. Steinel Philippsburg NPP, Germany
- Mr. S. Zorrilla Laguna Verde NPP, Mexico

What is ‘work management ’

- An iterative approach
- Using multi-disciplinary teams
- Involving all stakeholders
- The reports contains the main aspects of each topic, illustrated by practical examples from the ISOE community



Regulatory aspects

- Regulation provides for **an effective radiological protection infrastructure** which includes a “safety culture” shared by those with protection responsibilities from workers through to management
- In the field of radiation protection, **specific rules can be introduced to foster the optimisation** of radiation protection
- In addition to the regulatory framework, **utilities can develop their own radiation protection internal rules**, integrating operational restrictions for the management of individual and collective doses.

ALARA Management Policy

- **ALARA is a 'way of thinking'**
- But need to set up and structure **dedicated ALARA programmes** that **make explicit the goals and objectives of the utility** regarding optimisation of radiation protection
- **Responsibilities** should be clearly distributed among the various management levels and work specialisations
- Creation of **ALARA Committees** or other types of specific ALARA organisations are a key element, forming 'meeting points' between the main actors in ALARA implementation
- This favours their **involvement** in the ALARA programme as well as the **common elaboration** of ALARA plans.
- Plant management must be willing **to support, in policy and budget,** a multi-disciplinary team approach to plan, schedule, implement, and follow-up jobs.

Example from Korea

Korea: ALARA organisation and responsibility (KHNP)

KHNP revised its ALARA programme and developed a standard ALARA procedure to meet ICRP-60 recommendations implemented by Law (1998). Previous ALARA procedures had been applied to each plant until the standard procedure was developed for all plants in 2000. The organisation and responsibilities of the ALARA Committee and ALARA Practical Committee, shown below, are described in the standard procedure.

Position	ALARA Committee	ALARA Practical Committee
Chairman	Plant manager	Radiation safety manager
Secretary	Radiation safety section manager	Radiation protection section chief
Members	Vice-plant manager QA manager All-plant manager Subcontractor manager	Workgroup section chief Subcontractor workgroup manager Radiation service subcontractor manager Member recommended by the Chairman

The ALARA Committee is responsible for general ALARA programme reviews (RP policy, annual target, long-term ALARA strategy, etc.) Both committees are responsible for the following items, depending on the expected job doses:

- Review of radiation protection optimisation planning; Post-work ALARA review if actual dose exceeds the expected dose by 25%.
- Review of the radiation safety control plan.
- Review of the optimisation plan for radiation protection (whenever requested by a chairman).

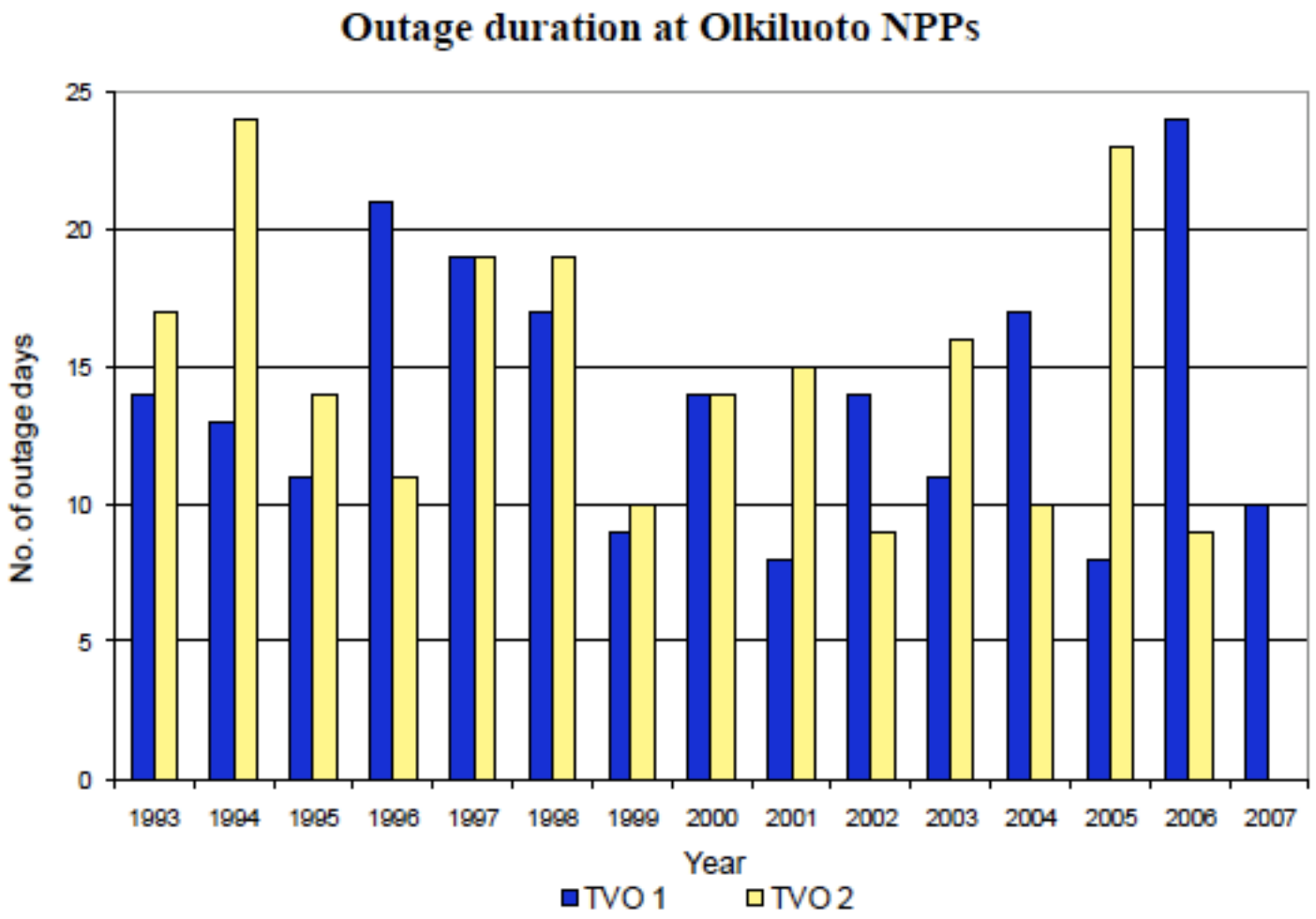
Worker Involvement and Performance

- **Factors contributing to workers' involvement**
  - Education and training in RP
  - Role of management at all levels:
    - Show (demonstrate) their commitment towards ALARA
    - Encourage feed-back from workers
  - Involving workers in planning, preparation and ALARA reviews
  - Regular information and communication
  - Incentives programmes recognizing ALARA performances

Work Planning and Scheduling

- Optimising **outage duration**
  - Work selection and scheduling
- Assign **RP responsibilities to maintenance planners**
- Integrate **RP aspect in work scheduling**
  - ‘Time-based’, ‘resource-based’ and ‘area-based’ scheduling
  - Use of advanced imaging tools
- Use of **detailed Radiation Work Permit**
  - Collective and mean individual dose prediction
  - Predicted dose rates
  - RP actions
- Specific planning and ALARA preparation for **high dose jobs**
- Use of **benchmarking**
- **Personnel preparation**
  - Mock-up training

Example of outage duration



Work Preparation

- All activities to prepare the site or the work crew
  - **Source term characterisation**
    - CZT (Cd, Zn, Te) spectrometer
    - Combination gamma scanning techniques and 3D dose simulation in dose optimisation
  - **Source term reduction techniques**
    - Chemical decontamination
    - System flushes
    - Surface decontamination technologies
    - Water chemistry control
    - …
  - **Exposure reduction techniques**
    - Temporary and permanent radiation shielding
    - Robotic
    - Specialised tooling
    - …

Examples of shielding

Belgium: Biological shielding during outages (Doel NPP)

At Doel NPP, the personnel assigned to install biological shielding is extremely well qualified and trained. The company to which they belong has prepared, over a number of years, a standard programme for installing biological shielding at the start of a unit outage. Its operatives are also radiation protection workers and the only ones, apart from the radiation protection workers of the plant and the contractor organisations, authorised to make certain dose rate measurements. All the biological shielding is installed in the first two or three days of the outage. Only the radiation protection department is authorised to move biological shielding, or to modify the nearby signs (indicating hot points, zone classification, etc.)

Installation of biological shielding on a pipe enabling monitoring of a valve

"Bracelet" type protection on a pipe

Examples of decontamination techniques

Japan: T-OZON chemical decontamination procedure

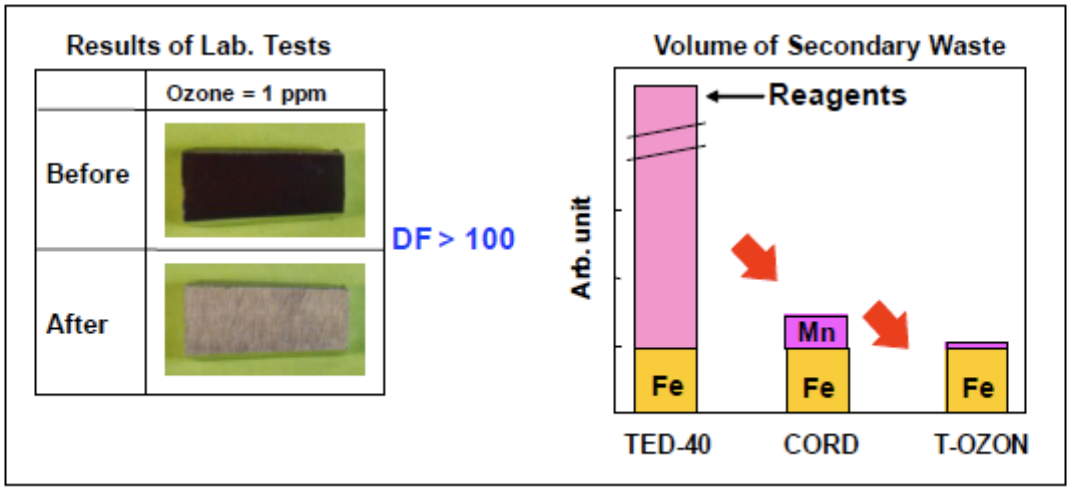
The principle of chemical decontamination is based on dissolution of metal oxides on materials. Dissolved metals, such as Fe and Cr, can be removed easily by an ion exchanger. Superior decontamination technology can achieve a high decontamination factor, minimum secondary waste, and no adverse impacts on material integrity. Based on these characteristics, the T-OZON decontamination process was developed in Japan. The principle of T-OZON process is as follows:

- Oxalic acid reduces ferrites to soluble Fe; ozone oxidizes chromites to soluble Cr.
- After the chemical reactions, both reagents can be easily decomposed.

In the T-OZON process, the secondary wastes of reagents are O_2, CO_2, and H_2O. The volume of secondary wastes can be decreased dramatically.

The main features of the T-OZON chemical decontamination process are:

- High decontamination factors.
- Minimum secondary waste volume.
- No adverse impacts on material integrity.



Work Implementation

- Division of **responsibilities**
  - Task managers/job supervisors
  - RP personnel
- **Access control systems**
  - Radiation work permit and controlled zone
  - Electronic dosimetry systems
  - High radiation areas access control
- **Remote monitoring systems**
- **Control of contamination**
- **Avoidance of unnecessary dose** and reduction of transit exposure
- **Avoidance of reworks**
- **Waste management**
- **Collection of feedback**

Example of contamination control

Germany: Covering the reactor pool against airborne activity

Some German PWRs (Philippsburg, Neckarwestheim, Isar) have used balloon silk to cover the reactor pool before its refilling during the outage. Two mobile ventilation filtering fans catch any aerosols beyond the cover and transfer them to the ventilation system of the reactor building. The advantages of this process are:

- No release of airborne activity into the containment and no induced contamination in the reactor building.
- No need of large decontamination works in the reactor building.
- No restriction for the workers caused by carrying additional clothing or respiratory equipment.
- No limitation of the number of persons in the containment because the personal lock remains open during the refilling time.
- 50% to 70% reduction in the refilling time (8 to 10 hours) on the critical path of the outage.

Work Assessment and Feedback

- Need to consider '**internal**' and '**external**' information
- **Job reviews and follow-up**
  - To be conducted by multidisciplinary teams
- Use of **operational experience databases**
- **Comparison of ALARA practices**
- Programme **audits**

Ensuring Continuous Improvement

- Operating plants and new designs

- A range of **new technologies to be considered**
  - Source term reduction : low cobalt materials, surface treatment within piping, installation of filters, …
  - Implementation of shielding at the design/construction stage
  - Remote monitoring systems
  - Robotic technologies
  - Maintenance-free components

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