



International Atomic Energy Agency

Decommissioning of Nuclear Facilities

The Transition Phase

Lawrence E. Boing
Manila, Philippines, October 2006

1

Lesson Objectives

- **Discuss how the transition phase interrelates with the overall decommissioning process**
- **Understand those activities normally performed during the transition phase and why they are performed during this stage**
- **Understand how the actions presented optimize the planning for and the conduct of the eventual final dismantling activity**

2

International Atomic Energy Agency



Facility Transition

The time period between facility shutdown and implementation of the decommissioning strategy

3

International Atomic Energy Agency



Stages in a Facility Lifetime

Facility Stage	Design, Construction & Start-up Phase	Operating Phase	Shutdown	Safe Enclosure Preparation	Safe Enclosure Period	Final Phase
Decommissioning Activity	Initial Decommissioning Plan	Update Decommissioning Plan Finalize Safe Enclosure Plan & Prepare Shutdown Plan	Source Term Reduction, Defueling & Waste Conditioning Prepare Site Preparation Plan & Surveillance & Maintenance Plan	Site Preparation & Initial Dismantling	Update Final Decommissioning Plan Surveillance & Maintenance	Final Dismantling, Final Survey & License Termination

4

International Atomic Energy Agency



Typical Transition Activities

- Allowable under an Operating License
- Facility, system and organizational modifications will be necessary
- Tasks that would occur as a part of routine nuclear facility operations
 - Housekeeping
 - Waste removal
 - Decontamination
 - Work area radiation surveys

5

International Atomic Energy Agency



Typical Transition Activities contd.

- Management and staff sized to conform to new operational requirements
- No irreversible actions are normally allowed – focus is on reducing risks and reducing costs
- Provide assurance that conditions at the facility are not a potential threat to public health safety or the environment

6

International Atomic Energy Agency



Organizational Modifications

- This process is an important part of the process - to change the culture or mindset of the former operations staff from operations to one of a 'new mission'-transition
- Appropriate changes are necessary to the organizational structure of the licensee to reflect the establishment of a decommissioning project team
- Staff must be appropriately trained to perform the transition functions
- Establish interfaces with stakeholders to build confidence and acceptance in decommissioning process

7

Organizational Modifications contd.

- Staff organizes / gathers the records and resolves any technological issues / uncertainties for finalizing the facility Decommissioning Plan
- Remember – the charge of the management staff during transition is to maintain facility safety while achieving reductions in the required efforts to perform surveillance and maintenance until the decommissioning strategy can be finalized and implemented

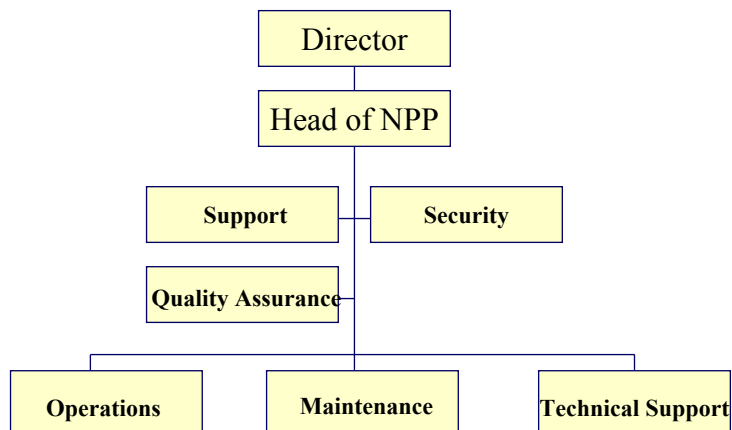
8



International Atomic Energy Agency

An example of the facility organizational structure evolving from Operations mode to Decommissioning mode

9

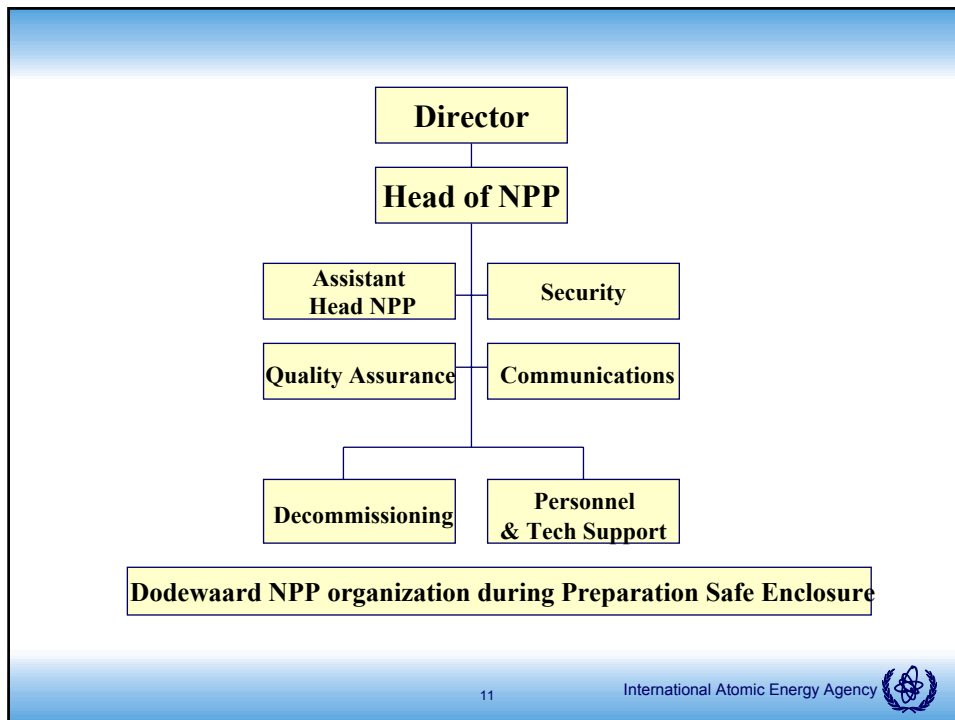


Dodewaard NPP organization during normal operation

10


International Atomic Energy Agency





Licensing during Transition

- **Dependent upon the Member State specific processes and responsibilities**
- **Member States need to ensure that during this potentially higher risk period that adequate oversight is provided until facility is transitioned through to a safe shutdown condition**
- **May have some relaxation in operational requirements as spent fuel removal and other nuclear material is removed from site**

12 International Atomic Energy Agency 

Licensing during Transition contd.

- Preparations can begin for license application necessary for implementation of decommissioning strategy
- Environmental evaluations of the impact of implementing the decommissioning strategy should be performed
- A permanently shutdown facility does not present the same safety concerns as an operating (nuclear material) facility

13

Operational Concerns

- Many routine and non-routine operations will take place during the transition period
- Special procedures and processes may require special authorizations from the regulator – large component shipments, increased effluent discharges, etc.
- Some activities that do not necessarily require regulatory approval will require administration reviews and/or controls – systems draining, chemical decontamination, waste removal, etc.

14

Operational Concerns contd.

- **Diligence is required in order to stay aware of changes in the operating conditions on a daily basis in any given area due to activities which may be underway**
- **Careful updates to facility records, procedures and drawings are required to be made in a timely manner**

15

International Atomic Energy Agency



Social and Economic Modifications

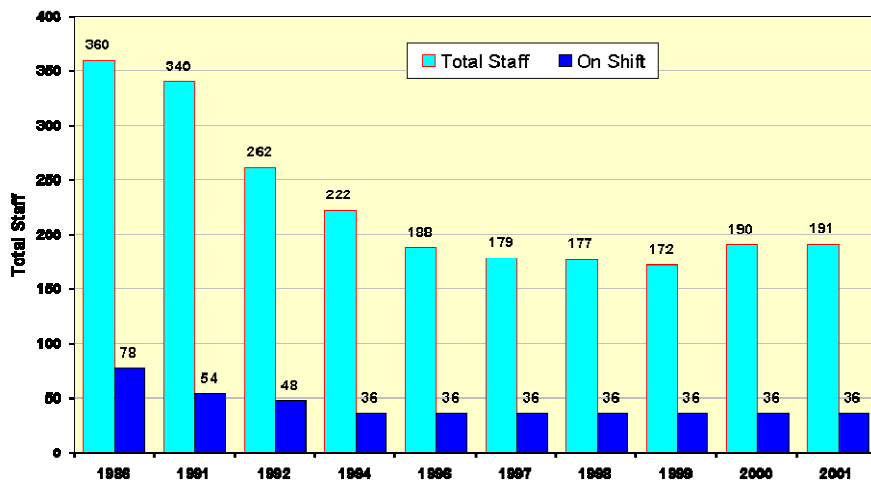
- **The uncertainty of future employment of the operating staff will be a concern - typically staff reductions are inevitable**
- **Key staff need to be retained (perhaps by incentivization – bonus incentive) to remain on staff and assist with transition activities and even with decommissioning**
- **Secondary impacts to the local economy will include loss of certain tax revenues and loss of certain local services**
- **Communication with stakeholders at all levels – employees, labor unions, the public, and local government – is very important**

16

International Atomic Energy Agency



Example of staffing profile at Caorso NPP (Italy)



17

International Atomic Energy Agency 

Acceptable Activities

- Nuclear material removal
- Circuits draining
- Utility isolation – water, electric and security
- Records review and archiving
- General work areas clean-up
- General decontamination

18

International Atomic Energy Agency 

Acceptable Activities contd.

- Radiological controls
- Ventilation system requirements
- Fire and flooding protection
- Facility scoping surveys
- Structural stability
- **NOTE:** Some – if not all - of these activities may well be handled on a parallel path scheduling basis

19

International Atomic Energy Agency



Nuclear Material Removal

- Important activity during the transition process; typically documented in a Waste Management Plan
- Transition will normally address removal of existing nuclear materials on-site: namely spent fuel, sealed sources and other operations related nuclear materials
- This removal will allow the licensee to greatly reduce associated accountability, safeguards or other security requirements

20

International Atomic Energy Agency



Nuclear Material Removal contd.

- **Spent fuel should be removed and/or shipped to either an 'away from reactor' storage facility or placed into some other approved storage mode appropriate for the national strategy for dealing with these materials**
- **Spent fuel removal is a critical path activity to facilitate implementation of decommissioning**
- **Careful consideration must be given to performing proper safety evaluation, training of personnel and evaluation of accident scenarios**

21

International Atomic Energy Agency



Nuclear Material Removal contd.

- **For operational wastes removal, a temporary increase in waste processing would be expected typically only to be exceeded during eventual facility dismantling**
- **All wastes need to be properly characterized, documented, segregated and conditioned for eventual disposal**

22

International Atomic Energy Agency



Circuits Draining

- **Circuits in the facility should be drained and isolated in order to:**
 - **Eliminate those no longer required for eventual decommissioning, security, nuclear material processing or effluent monitoring**
 - **Utilize expertise of plant staff**
 - **Minimize presence of any potentially hazardous material**
 - **Minimize potential of contamination spread**
 - **Reduce general area radiation exposure rates**
- **Provisions must be made to handle the large volumes of resulting liquids which will require handling, treatment and disposition**

23

International Atomic Energy Agency



Utility Isolation

- **Utilities routinely requiring some consideration include: water and steam systems, sanitation and sewer systems, electrical systems and security systems**
- **Certain utility services to entire areas or buildings may be able to be isolated**
- **Water and steam systems should be isolated and drained; sanitation and sewer systems are normally abandoned and/or removed**
- **Security enhancements may be necessary including access controls if not already in place**

24

International Atomic Energy Agency



Utility Isolation contd.

- **Electrical services should be evaluated and consideration given to electrically isolating the facility – although some minimal amount of service will still be required for surveillance and maintenance activities**
- **Options available include:**
 - **Isolate and reconfigure existing system**
 - **Add alternate sources of power combined with abandonment of some systems**
 - **Complete reliance on hand-held and portable equipment**

25

International Atomic Energy Agency



Records Review and Archiving

- **In preparation for shutdown, post-shutdown and eventual decommissioning, it is necessary to start early on the assembly of all pertinent records in a central location**
- **There will be two broad classes of records: those that will need to be transferred to the caretaker or decommissioning organization and those that can be archived at this time**
- **Typically there is some guidance available from the national authorities on how this process is to be implemented**

26

International Atomic Energy Agency



Records Review and Archiving contd.

- **Archive Records**

- **Examples**

- ▶ **Quality records – QA records, radiation exposure records**
 - ▶ **Operation/Maintenance records – data sheets, log sheets, effluent discharges**
 - ▶ **Environmental records – regulatory agreements, environmental monitoring records**

27

Records Review and Archiving contd.

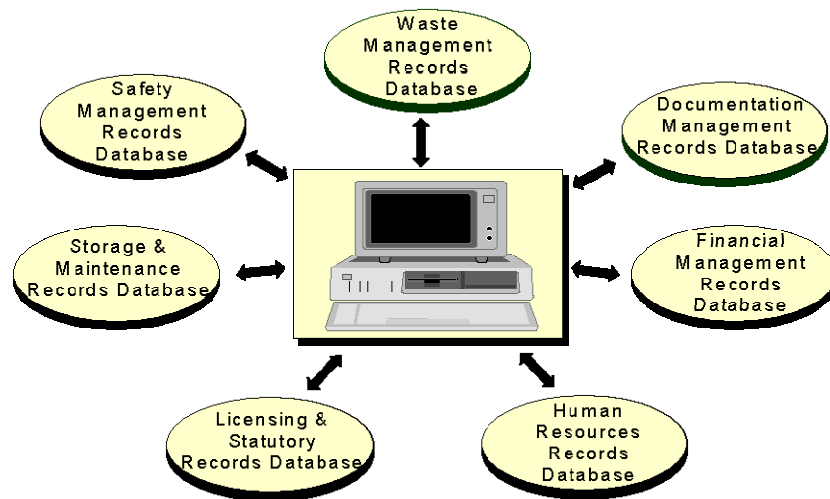
- **Turnover Records**

- **Examples**

- ▶ **Operating equipment list and procedures**
 - ▶ **Final radiological surveys**
 - ▶ **Facility permits**
 - ▶ **Detailed as built drawings**
 - ▶ **Crane and other facility maintenance records**

28

Example of an Integrated Records Management System



29

International Atomic Energy Agency



General Work Areas Clean-up

- Over time work areas may tend to accumulate loose items in different areas
- By performing this work now there may still be some knowledgeable staff available to assist with the optimization of this process
- Long neglected areas and equipment should be given special attention

30

International Atomic Energy Agency



General Work Areas Clean-up contd.

- **There is a tendency for researchers and operators to store rather than dispose of old equipment, excess material and spare parts**
- **Some equipment and other items that are able to be released should be cleaned out of these areas and others appropriately tagged for disposition**

31

International Atomic Energy Agency



General Decontamination

- **Larger areas with higher levels of contamination may be decontaminated using surface flushing to facilitate further surveillance and maintenance and to assist with radiological controls in these areas**
- **Various systems may require clean-out and flushing depending on hazards present, benefits gained and how these relate to required post-operational surveillance and maintenance activities**
- **Consideration should be given to chemical hazards posed to workers from decontamination agents or compliance with environmental regulations and/or permits**

32

International Atomic Energy Agency



General Decontamination contd.

- **Cost/benefit analyses should be used (focussing on waste volumes generated) as well as the future need to access various areas to determine areas that should be considered for decontamination**
- **Unless significant controlled area size reductions can be achieved, it may be more prudent to focus on only general decontamination of areas**

33

International Atomic Energy Agency



Radiological Controls

- **Utilize confinement barriers to prevent and control contamination spread**
- **Barrier integrity is maintained and provisions established to ensure their integrity through decommissioning**
- **Various controls may be necessary to limit opportunities for contamination spread and to minimize the possibility for contamination migration including:**

34

International Atomic Energy Agency



Radiological Controls contd.

- **Use of various sealants and fixatives to seal or fix contaminants**
- **Bird and animal proofing to eliminate the possibility of contamination spread**
- **Often postulated accident conditions in the SAR change for the decommissioning situation compared to the operational situation – containment requirements may also change**

35

International Atomic Energy Agency



Ventilation System Requirements

- **Planning should be performed for future facility ventilation needs after shutdown**
 - **Some areas may not need any installed ventilation – only portable units will be used in the future**
 - **Some areas may require use of installed ventilation periodically prior to and during entries**
 - **Other areas may require continuous ventilation for contamination control or temperature control**

36

International Atomic Energy Agency



Ventilation System Requirements contd.

- Reduced flow rates may be possible with reductions in operations
- Consider changes to environmental monitoring

37

International Atomic Energy Agency



Fire and Flooding Protection

- Fire protection strategy should be to eliminate all fire hazards to the greatest extent possible
- Some likely problem areas may include oils and grease hold-up in different systems and components which although emptied and flushed may still have some residual material present
- Flooding protection may be a concern after shut-down depending on the geographic location and specific climate and geology/hydrology of the area
- Some areas may require sealing or the maintenance of certain active collection, detection and pump out systems

38

International Atomic Energy Agency



Facility Radiological Scoping Surveys

- Scoping surveys should be used to supplement the operational survey records to gain basic knowledge of the facility radiation condition
- An extensive and intensive characterization is not appropriate at this time; information should include that gleaned from operational records, process knowledge and limited sampling and measurements

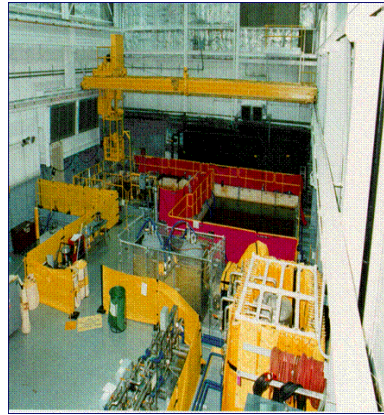
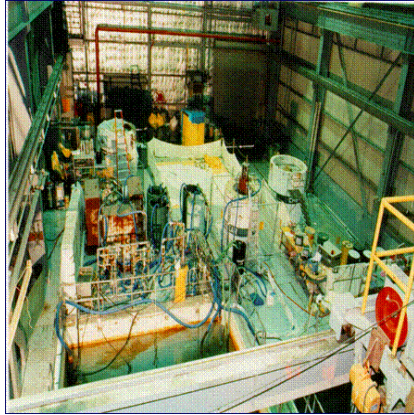
39

Facility Radiological Scoping Surveys contd.

- The primary objectives of the scoping survey should be to:
- Provide data for the preliminary assessment of hazards
- Support classification of areas as contaminated or non-contaminated
- Provide input into the details characterization survey design
- Determine if hazards are present other than radiological hazards

40

Before and After Photos of Commercial NPP Prototype – a Deactivation Success



41

International Atomic Energy Agency 

Structural Stability

- The purpose of this activity is to determine and document the adequacy of an extended non-operational period
- A tailored approach to this activity is appropriate with a level of detail consistent with the planned future use of the facility (if any) and a review of potential hazards to the workers, the public and the environment
- Periodic future inspections on some regular frequency may be warranted

42

International Atomic Energy Agency 

Structural Stability contd.

- **Facilities which are internally contaminated should ensure that the roof of the structure is sound and will serve its intended purpose**
- **Routine inspections and assessments should be made to document conditions with the passage of time until final dismantling can occur**

43

International Atomic Energy Agency



Summary

- **There are numerous actions that can be taken prior to or during actual facility shutdown that optimize eventual dismantling**
- **The steps taken should be evaluated to ensure that they are: 1) allowable under the operating license and 2) not pre-determining decommissioning options available for the facility**
- **When completed, these steps detailed here should place the facility in a safe shutdown condition and well situated until the final dismantling activities can be commenced**

44

International Atomic Energy Agency



References

- IAEA Safety Report #31
- IAEA Safety Report #36
- IAEA TRS #420