Lesson Objectives

- Review the basic safety principle of Integrated Safety Management and its applicability to decommissioning activities
- Review typical decommissioning workplace hazards
- Reinforce the fact that while radiation protection is still critical, industrial safety (non-radiological hazards) pose an ever greater hazard as the work progresses
- Describe the concept of a project-specific Health & Safety Plans for a decommissioning project
- Review the various accident opportunities and mitigative measures available to address those
### Health & Safety During Decommissioning (1)

- **GOAL:** protect workers, the public and the environment
- Safety assessment must be performed to identify hazards (radiological and non-radiological)
- Hazards and protective measures may be different than during operations
- Expect new hazards as abandoned systems are opened or barriers to confine radionuclides (e.g. hot cell) are removed
- IAEA is empowered to prepare nuclear standards (exception TRS 441)
- Use national standards on industrial safety

### Health & Safety During Decommissioning (2)

- In general, radiological hazards decrease and industrial hazards prevail throughout the decommissioning process
- Conditions may change daily (drastic difference to operations)
- Maintain worker awareness and keep them alert of new hazards
- Health and safety are an integral part of all operations
Principles of Integrated Safety Management

- Clear roles and responsibilities are required (if everybody is responsible, then nobody is responsible /accountable)
- First, not lowest level management is responsible for safety
- Identification of hazards and carefully deal with them
- Hazard controls should be tailored to the work to be done
- Work authorization; incl. a clear description of work to be done (no shortcuts!)

Integrated Safety Management

1 - DEFINE WORK SCOP
2 - ANALYZE THE HAZARDS
3 - DEVELOP AND IMPLEMENT HAZARD CONTROLS
4 - PERFORM WORK WITHIN CONTROLS
5 - PROVIDE FEEDBACK AND CONTINUOUS IMPROVEMENT
Although the largest number of documented events deal with radiological hazards, they reflect the lowest actual personnel risks of the categories shown.

Typical Hazards in a D+D Environment (1)

- Chemical exposure hazards
  - Asbestos, solvents, toxic elements / metals or compounds (Ingestion, inhalation, skin)

- Mechanical impacts (drop of heavy items, collapse of structures)

- Noise
  - Machinery, close working quarters

- Light exposure
  - Laser, ultraviolet, infrared, etc.

- Ergonomics
  - Vibration, heavy equipment, computers, laboratory equipment, lifting of devices, etc.
Typical Hazards in a D&D Environment (2)

- Biological hazards
  - Agents in ventilation systems and static areas
  - Droppings from animals in the building
  - Plants, infected animals and insects
- Electrical
  - Removal of services
  - Temporary services
- Explosives
  - Facilities working with explosives, demolition, construction-nail guns
  - High pressure systems (compressed air, gas bottles etc.)
- Operation of heavy equipment and power tools

Typical Hazards in a D&D Environment (3)

- Overhead work
  - Falling objects, struck against (door, iron bar etc.)
- Environmental conditions
  - Heat, cold, wet, slippery, limited visibility
- Housekeeping
  - Construction debris, dismantlement debris
- Confined spaces not designed for entry of humans
- Welding and cutting
  - Industrial hazard, fumes
  - Fire
Typical Hazards in a D&D Environment (4)

- Material handling (lifting, stacking etc)
- Excavations
- Rigging and hoisting
- Toxic and hazardous substances
  - Chemicals
  - Radioactive materials
- Material handling
- Protect people from falling

Typical Hazards in a D&D Environment (5)

- Field sanitation
- Insufficient illumination of working areas
- Non-ionizing radiation hazards (e.g. laser beams)
Industrial Hygiene Programme

- Industrial hygiene monitoring in a decommissioning environment
  - Identify hazards (e.g. past activities)
  - Take changing conditions into account (e.g. increase of contamination levels) and re-evaluate hazards
  - Control hazards (protect workers, prevent false allegations)
  - Develop workplace monitoring programme
  - Decide on the monitoring needs (air, workers / continuous, real time, periodic, random etc.)

- Take records and make an appropriate documentation

- Hazardous chemical may include:
  - Continuous exposure limit
  - Short term exposure limit
  - Immediately dangerous to life and health limit

Safety Management Principles

- Injuries are preventable

- A sound safety programme includes
  - Requirements (derived from safety standards)
  - performance standards (derived from requirements)
  - implementing procedures (derived from performance standards)

- Train, teach, motivate workers and refresh safety issues

- Continuous feedback from workers to determine what works well

- Quickly correct deficiencies, unsafe acts and unsafe conditions

- Discipline those violating safety

- Management must be committed to safety (listen to workers, take up good suggestions, enforce safety)
Elements / Techniques to mitigate hazards

- Health and Safety Plan
- Worker training
- Good planned approach
- Proper facility and waste characterization
- Proper protective equipment
- Integration of safety and engineering into operations

The Health and Safety Plan (1)

- Consolidates
  - Radiation Protection Plan
  - Nuclear Criticality Safety Plan (if applicable)
  - Industrial Health and Safety Plan

- Other Related Information
  - Audits and Inspections
  - Record Keeping
  - Dose Estimation and Optimization
  - Clearance Criteria for materials
  - Final Release Criteria for buildings and sites
The Health and Safety Plan (2)

• Radiation Protection Plan
  • Provides a description of the radiation protection programme
  • Includes at least the following information:
    • Responsibilities
    • Local dose rate measurement
    • External exposure monitoring
    • Workplace air sampling
    • Respiratory protection
    • Internal exposure monitoring
    • Contamination control programme
    • Instrumentation
    • Training
    • Other radiation protection concerns

The Health and Safety Plan (3)

• Nuclear Criticality Plan
  • Applicable if criticality concerns still remain after transition phase
  • Includes at least the following information:
    • Responsibilities
    • General programme implementation
    • Training
    • Results of new criticality analysis
    • Criticality safety requirements
    • Monitoring instrumentation
    • Alarm system and response to alarms
The Health and Safety Plan (4)

- Industrial Health and Safety Plan
  - Covers all conventional safety issues
  - Includes information on the following issues:
    - Fire safety, construction safety, hoisting and rigging, electrical, elevated work, heat/cold stress, power and hand tools, motorized vehicles and equipment, work environment, material handling and storage, high pressure safety, chemical safety, industrial safety
  - Includes methods for factoring safety requirements into work procedures
  - Procedure approval process
  - Personnel protective measures and systems
  - Protective signs, instruments, clothing and equipment
  - Work permit system
  - Responsibilities and training
  - Documentation

The Health and Safety Plan (5)

- Audits and inspections
  - Annual review of radiation and industrial safety programmes
  - Types and frequency of audits and inspections
  - Responsibilities
  - Records / documentation
  - Procedures for evaluation and handling violations

- Record Keeping Programme
  - Specific to safety related records
  - Required records should be identified, retention period specified and eventual disposition
  - Responsibilities for completion and retention
  - Location of records identified
  - Method for storing the information
The Health and Safety Plan (6)

• Optimization analysis
  • System for determining optimization (cost / benefit)
  • For doses and occupational hazards
  • Lessons learned programme

• Dose estimation
  • For major tasks presenting a significant dose commitment or hazard
  • Estimate of whole body and extremity doses
  • Include all pathways and all types of radiation
  • Identify engineering controls and administrative measures to reduce exposures
  • Comparison of estimated dose with relevant limits

The Health and Safety Plan (7)

• Clearance criteria
  • Measurable data for releasing equipment, material, waste, buildings and sites
  • Data depend on end point definition
  • Reference to applicable regulatory requirements
  • Final overall radiological survey (site and other remains)
  • Procedures to be used to verify criteria have been met

• Documentation needed
  • Documentation system
  • Storage and maintenance of documents
  • Time frame
Accident Types

- Struck by
- Struck against
- Contact by
- Contact with
- Caught on
- Caught in
- Caught between
- Foot level fall
- Fall to below
- Over exertion
- Exposure

- Refine:  
  - Area of body (hand, head etc.)
  - Type of injury (cut, fracture etc.)

All of the listed types of accidents could happen at a decommissioning project site.

The industrial incidents, not the radiological incidents have an immediate effect and the most attributable effect also.
Large gap

Electrical work in an pool of water

No comment needed
Results of an Accident

- Annoyance
- Production Delays
- Reduced Quality
- Spoilage
- Minor Injuries / First Aid Cases
- Disabling Injury
- Fatality

Summary

- Expect the unexpected: radiological and non-radiological hazards will continually change as the work progresses with the increased possibility of non-radiological hazards becoming more common
- Effective safety programmes are fully integrated into operations and maintenance
- Workers must recognize and mitigate hazards
  - Training, briefings, feedback, motivation etc. must be used to achieve worker awareness and to avoid complacency
  - Commitment of first line management is key to safety
- GOAL – protect the worker, public and environment
References

- IAEA WS-R-2
- IAEA Safety Series No. 115 BSS
- IAEA Safety Guide WS-G-2.1
- IAEA Safety Guide WS-G-2.2
- IAEA Safety Guide WS-G-2.4
- IAEA RS-G-1.7 Application of the concepts of exclusion, exemption, clearance
- IAEA DS 332 Release of Sites from Regulatory Control on Termination of Practices
- IAEA DS 333 Decommissioning Safety Requirements
- IAEA Fundamental Safety Principles, DS298 – approved to be published, 2006
- TRS No. 441 non-radioactive hazardous materials (2006)