Onshore Decommissioning Overview

- The decommissioning of onshore facilities occurs when the reservoir is depleted or the production of hydrocarbons from that reservoir become unprofitable.
- Parts of the onshore facilities, such as the aboveground facilities located in the oil or gas field area and along the transmission lines, are treated to remove hydrocarbons and other chemicals and wastes or contaminants.
- Other components, such as flowlines and pipelines, are often left in place to avoid environmental disturbances associated with removal.
- Wells are plugged and abandoned to prevent fluid migration within the wellbore or to the surface. The downhole equipment is removed and the perforated parts of the wellbore are cleaned of soil, scale, and other debris. The wellbore is then plugged. Fluids with an appropriate density are placed between the plugs to maintain adequate pressure. During this process, the plugs are tested to verify their correct placement and integrity.
- Finally, the casing is cut off below the surface and capped with a cement plug

Purpose – Onshore Well Plug & Abandonment

Objectives:

- Review steps in an onshore well P&A
- Provide overview of Well P&A Process

Well Plug and Abandonment

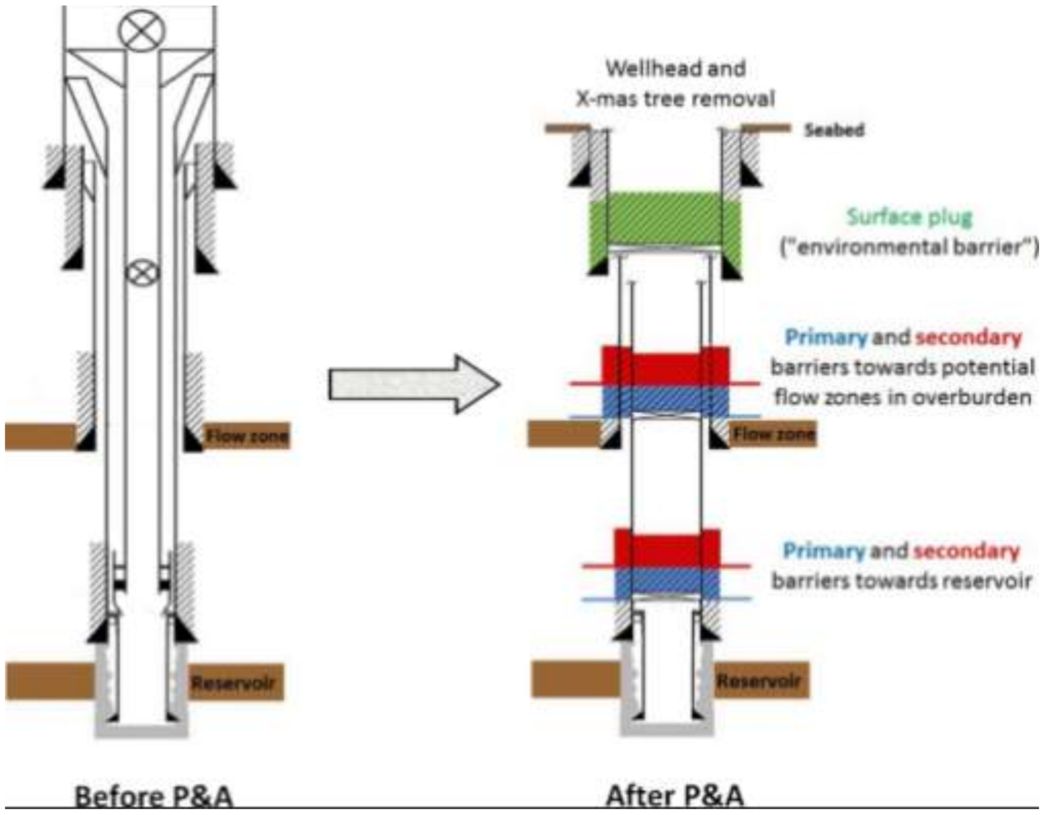
- The purpose of plugging wells is to:
  - prevent interzonal migration of fluids;
  - the contamination of freshwater aquifers, surface soils, and surface waters, and
  - to retain hydrocarbons either in the production interval or potential production intervals.

Well Plug and Abandonment

- Generally, contamination by an improperly plugged and abandoned well can occur in two ways:
    a. The abandoned well can act as a conduit for fluid flow between penetrated strata, into underground sources of drinking water, or to the surface.
    b. Contaminated water can enter the abandoned wellbore at the surface and migrate into underground sources of drinking water. Such contamination is prevented when a well is properly plugged.
- Plugging operations not only prevent an abandoned well from becoming a conduit for contamination to occur, but, well construction and completion methods also contribute to the prevention of contamination.
- The requisite outcomes of well abandonment are to achieve aquifer zone and production zone isolation that existed before the well was drilled and constructed

The P&A Process

- To plug the well, sections of the wellbore are filled with concrete to isolate the flow of reservoir fluids from each other and to the surface.
- An abandonment includes filling the entire wellbore from bottom to surface in cement ‘plug’ stages, with suitably dense, non-corrosive fluids between the plugs.
- All open hole ‘plugs’ are left to set and tagged to confirm placement before the next one is pumped.
- Once a cement ‘plug’ top is inside casing, it is left to set and tagged to confirm placement and pressure tested to confirm isolation.



The P&A Process

- Finally, the surface casing is cut off and a cap is welded in place several feet below the ground, as required by the regulators.

Pit Abandonment

Pit Abandonment

- All pits and surface impoundments should be closed, backfilled, and graded to conform to the surrounding terrain, after they are dry and free of waste.
- The location of abandoned pits should be documented.
- Materials removed from pits should be reclaimed, recycled or disposed. Documentation should be kept for disposed materials.

Land Restoration

Land Restoration

- Upon completion of abandonment activities, all disturbed surface areas should be cleaned up and restored to conditions similar to the adjacent land or to landowner requirements.
- Restoration should include stabilization and revegetation of disturbed areas using native plant species or approved seed mixes.
- Drainage and maintenance requirements should also be considered.

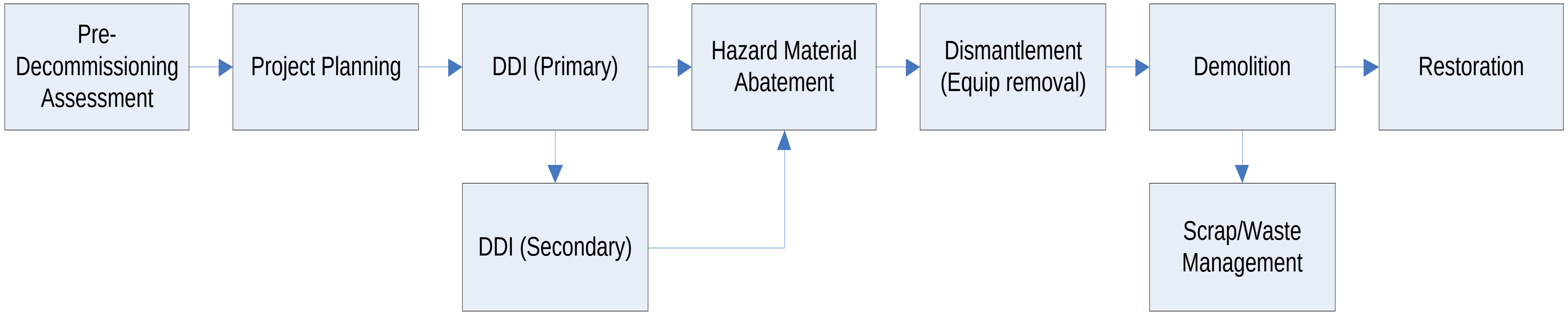
Purpose – Decommissioning Project

Objectives:

- Review steps in an onshore decommissioning project and identify critical steps
- Provide overview of decommissioning project process
- Review pointers for decommissioning projects

Decommissioning Stages - Facilities

1. Pre-Decommissioning Assessment
2. Project Planning
3. Operations DDI
4. “Decommissioning” DDI (Secondary)
5. Hazardous Material Abatement/Universal Waste
6. Dismantling/Equipment removal
7. Demolition
8. Scrap/Waste Management
9. Restoration



Pre-Decommissioning Assessment

- Complete and thorough assessment should be carried out as early in the project as possible (site visit mandatory)
- Building inventory for construction materials (steel, concrete, etc.), and potential hazardous/impacted building materials (ACM, PCBs, lead containing paint)
- Inventory of pits, sumps, support/ancillary equipment, process equipment, tanks/vessels/piping and residuals
- Survey for Asbestos; Radioactive materials; Lead based paint; Mercury, PCBs;
- Identification of other regulated material/universal wastes (CFCs, exit signs, mercury switches, etc.)
- Other building contamination due to former use (e.g., oil spill, dust with heavy metals, presence of NORM)
- Building material and residual material sampling to determine presence or confirm absence of impacts

Pre-Decommissioning Survey

Review of Potential Hazardous and/or Regulated Materials

- Asbestos-Containing Materials
- Lead/Cadmium based Paint
- Oil Containing Equipment and Devices
- PCBs
- Lead-Acid Batteries/Nickel-Cadmium Batteries
- Chlorofluorocarbons
- Air Pollution Control Equipment
- NORM
- Mercury
- Process related materials, residues and wastes

Benefits of a Thorough Pre-Decommissioning Assessment

- Selection of the best decommissioning/demolition method
- A more realistic schedule and cost estimate of the demolition
- Minimizes future liabilities
- Critical for HSSE planning
- Can reduce cost of demolition debris disposal
- Can maximize scrap recovery value
- Minimizes the "surprises"

Beads of mercury inside masonry wall

Project Planning

- The importance of proper front-end loading is essential for successful planning and execution of a decommissioning project, just as it is with any project.
- Decommissioning projects are very different from construction projects and are not construction in reverse.
- For decommissioning projects, a review of lessons learned, post project appraisals and other lessons captured should be conducted during project set-up.
- Data gathering plan (what do we need to track on this project for Continuous Improvement?)

De-Oil, De-Energize & Isolate

De-Oil / De-Inventory

- All stock products, liquids (sludge) and gasses in pipes, tanks and vessels
- Interceptors and drains
- Inspection & gas testing of atmosphere inside pipes, tanks and vessels
- Leave pipes & vessels open to atmosphere
- Air gapping is recommended

De-Energise

- Remove all sources of stored energy on site defined as

  Any chemical, electrical, gravity, hydraulic, mechanical, pneumatic, radiation, thermal or other source of energy that can cause harm to people or the environment

Isolate

- All utilities\supply lines onto and off site – remember that the decom activities will also need utilities-terminate first/then bring in re-routes

De-Oil/Inventory, De-Energize and Isolate (DDI)

- DDI is carried out during shutdown of site operations, however, DDI is more exacting when preparing to decommission the facility
- Generally Primary DDI is done by the facility operator
- A well executed DDI plan can help reduce safety risks, environmental risks, scope creep and cost increases
- Coordination with operations personnel for documentation of DDI activities is very important
- Typically secondary DDI is necessary once decommissioning contractor takes over site

Secondary De-Oil, De-Energize & Isolate

DDI is carried out during Shutdown of Site Operations, however DDI is more exacting when preparing to decommission/demolish

- May be residuals of gas and liquids in pipelines
- Tanks bottom sludge's or fluids may still be present
- Vessels may still contain flammable vapours
- USTs may not be identified or cleaned thoroughly
- Often the process chemicals and product inventories are still present
- Closed loops or isolated pressure in piping or vessels may still be present
- Residual waste materials may still be onsite

DDI – Energy Sources

Energy Sources for isolation

- Electrical (Motor Controllers, Capacitors, Circuit Breakers)
- Fluids and Gases (Piping Systems, Vessels, Production or Process Equipment, Machinery or Systems, Storage Tanks)
- Hydraulic (Valve Actuators, Presses)
- Mechanical (Pumps, Counterweights, Flywheels, Sprung Valves)
- Pneumatic (Starting Air, Control Valves, Instrument Air)
- Water and Groundwater associated with Pump-and-Treat Remediation Systems, Water Supplies
- Radiological (NORM/LSA tank bottoms, scale)

Hazardous Materials Abatement

- Environmental abatement of asbestos, PCBs, NORM, lead paint etc.
- The abatement of hazardous materials should be completed prior to demolition.
- Hazardous materials often have more regulatory requirements than other types of materials.

Spill Prevention Plans

- Spill prevention plans likely already prepared for facility to be decommissioned
- Spill prevention plans should be amended for proposed decommissioning
- Amended plan must include:
  - Identification of sensitive areas
  - Account for changes to site during works – hard-standing; drainage etc.
  - Refueling location(s) for decommissioning equipment
  - Location of Spill Kits
  - Emergency Response Procedures
  - Applicable training required for emergency response personnel

Storm Water and Erosion Control

What is going to happen when it rains during the decommissioning process?

- Storm water management: Control flow of surface water run-off in order to limit the offsite transport of sediment into public sewers / water bodies
- Erosion management of exposed soil / stockpiles when it rains

What are the issues?

- Source – Pathway – Receptor
- Sources
  - Water; contaminated liquids
  - Sediment picked up by moving liquids
- Pathways
  - Overland flow and on-site drainage ditches/ storm drains
- Receptors
  - Sewer Systems, Creeks, Rivers

Storm Water and Erosion Control

Example Erosion Control Best Management Practices

Drop Inlet Barrier

Rock Ditch

Dismantling (removal of equipment for reuse)

- An additional safety risk is posed by equipment dismantling versus use of demolishing equipment. Dismantling generally requires more hand-labour (e.g., rigging work) activities compared to demolishing equipment via machine.
- Value realized by re-deploying (re-use) asset equipment which requires dismantling should be weighed against the safety aspects of conducting the dismantling.
- Dismantlement may be necessary in some cases (example space limitations).

Demolition

- Demolition is safer and less expensive than dismantling.
- Demolition typically puts fewer workers at risk and emphasizes the use of shearing and other demolition specific equipment.
- The final scope of work should include an evaluation of the trade-offs (e.g. cost, schedule, safety) between dismantling equipment for re-use versus demolition and scrap recovery.

Scrap / Waste Management

- Separate out recyclable materials, including steel and other metals, during demolition.
- Seek re-use options for other demolition debris, such as clean concrete and brick rubble for road base or aggregate.
- Waste generated from the decommissioning project that does not have value for re-use or salvage must be disposed at an approved facility.

IOGP International Association of Oil & Gas Producers

Waste Management

Key Issues

- Expect unique/unusual wastes from sites – process waste, NORM, chemicals.
- Perform a thorough waste characterisation program (WCP).
- Selection of an approved waste transportation and disposal contractor knowing types/quantities of waste from WCP – avoid expensive surprises.
- Program in:
  - effective segregation of hazardous vs. non hazardous demolition debris during demolition
  - beneficial reuse of demolition debris
  - maximizes scrap recovery
- Spend time planning/scheduling of transport and disposition of demolition debris.

IOGP International Association of Oil & Gas Producers

Restoration

- Determine regulatory site closure requirements during the planning stage.
- Check existing lease or with current property owner for final site condition requirements.
- Habitat restoration can start before decommissioning activities with pre-assessment surveys to determine pre-existing conditions (flora and fauna species).
- Re-contouring, re-vegetation, restoration of the site.
- Disturbed areas may need Open Space and Habitat Management Plans.
- Final site conditions should be consistent with the intended future use e.g. restrictions/limitations on future use, agricultural use, native habitat restoration, redevelopment, industrial use.

Restoration Considerations

- Site suitability is critical (can’t force mother nature to fit your site)
- Restoration is long term (3 – 5 years)
- Environmental remediation is often associated with decommissioning and may take longer to complete than restoration
- Annual monitoring, reporting, and regulator inspections may be needed throughout
- Maintenance requirement during vegetation establishment is significant and critical
- Controllable risks – sufficient water, weed invasion
- Uncontrollable risks – extreme weather, pests, trespass
- Completion dictated by attainment of re-vegetation goals, not by time
- Maintain or renew access agreements

Summary – Decommissioning Project

- The phases of a decommissioning project are as follows:
  - Pre-Decommissioning Assessment
  - Project Planning
  - DDI
  - Hazardous Material Abatement
  - Dismantlement/Equipment Removal
  - Demolition
  - Waste/Scrap Management
- Proper front-end loading is essential for successful planning and execution of a decommissioning project, just as it is with any project.