



Recent Developments in Decommissioning and Radioactive Waste Management in Canada

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Outline of Presentation

- Decommissioning and Waste Management (D&WM) activities by the Electrical Utilities
- AECL D&WM activities:
 - Chalk River Laboratories (CRL), Ontario
 - Whiteshell Laboratories (WL), Manitoba
 - “Off-site” Shutdown Prototype Reactors (NPD, Douglas Point, Gentilly 1)
 - Low Level Radioactive Waste Management Office (LLRWMO), across Canada
- Long-term management of Canadian nuclear fuel waste



D&WM Activities by the Electrical Utilities

- Four Electrical Utilities currently operate 22 CANDU power reactors:
 - Ontario Power Generation (OPG) – 12 reactors
 - Bruce Power (Ontario) – 8 reactors
 - Hydro-Québec – 1 reactor
 - New Brunswick Power (NBP) – 1 reactor
- Status:
 - All radioactive wastes are stored at the reactor sites
 - Fuel is not reprocessed
 - No major decommissioning activities are under way
 - OPG has begun circulating information to the public about the need for a LLW disposal repository



AECL D&WM Mandate

- Manage “legacy liability” wastes that have arisen from AECL operations, and from Canadian hospitals, universities, and industry
- Establish enabling technologies for environmental remediation and disposition of wastes
- Decommission facilities/buildings on AECL sites
- Manage for the Federal Government “historic” wastes located across Canada (e.g., Port Hope, Scarborough, Northern Transportation route, Surry, B.C., radium-painting workshops, etc.)
- Develop and exploit technologies for long-term waste management (e.g., geologic disposal)



Scope of AECL “Legacy Liability” Activities (1 of 2)

- CRL and WL
 - buildings, structures & facilities (upgrade/decommission)
 - site services and “affected lands” (replace/restore)
 - Waste Management Areas (monitor, remediate)
- AECL Prototype Reactor Sites (NPD, G 1, DP)
- Glace Bay and Laprade heavy water production sites

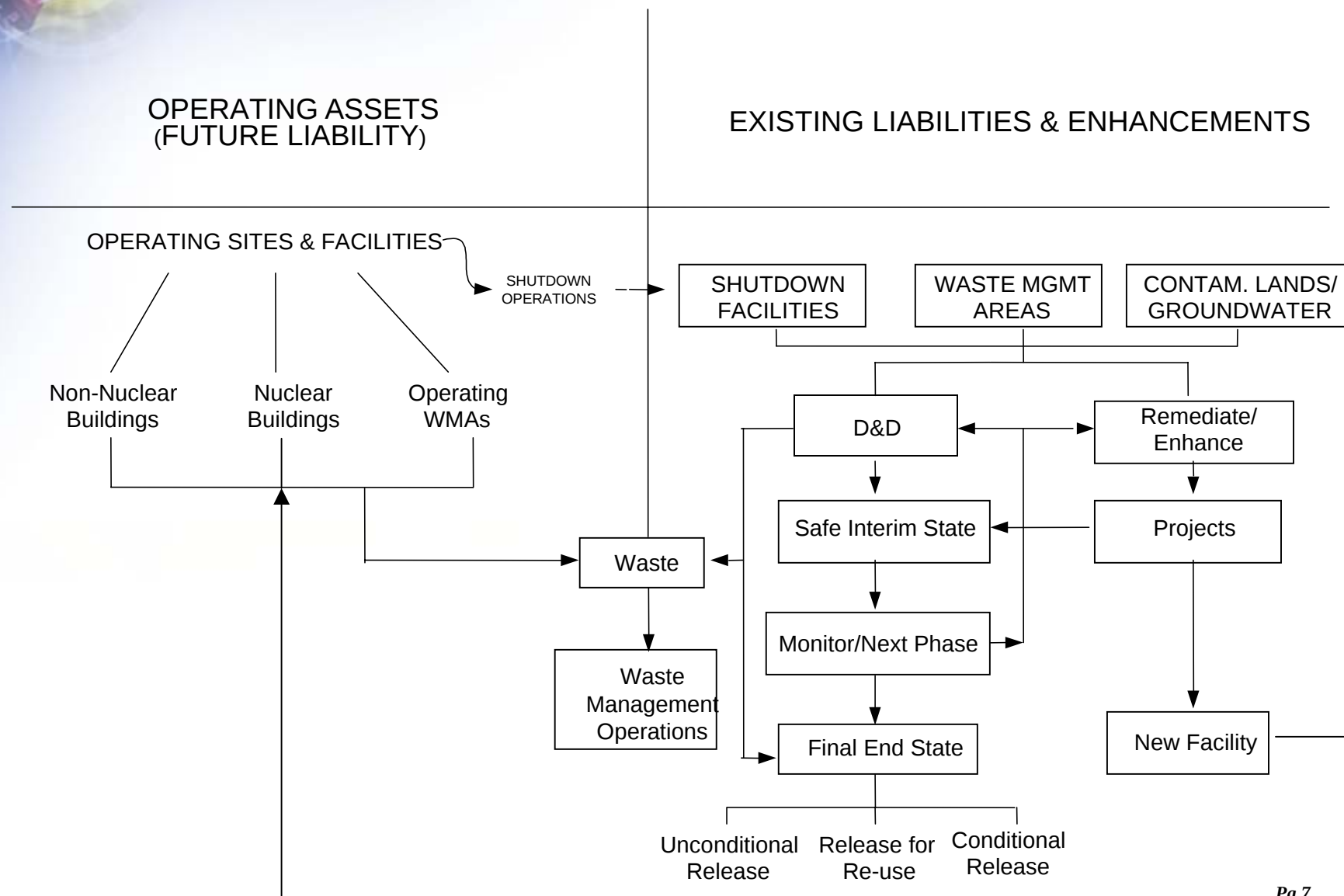


Scope of AECL “Legacy Liability” Activities (2 of 2)

- Construct the “enabling facilities” that are required to discharge the nuclear legacy liabilities:
 - Waste analysis facilities
 - Storage facilities
 - Shielded facilities
 - Waste processing, immobilization, and packaging facilities
 - Long-term waste management facilities
- Conduct the public consultation and environmental assessments associated with discharging the legacy liability



Decommissioning & Waste Management Activities

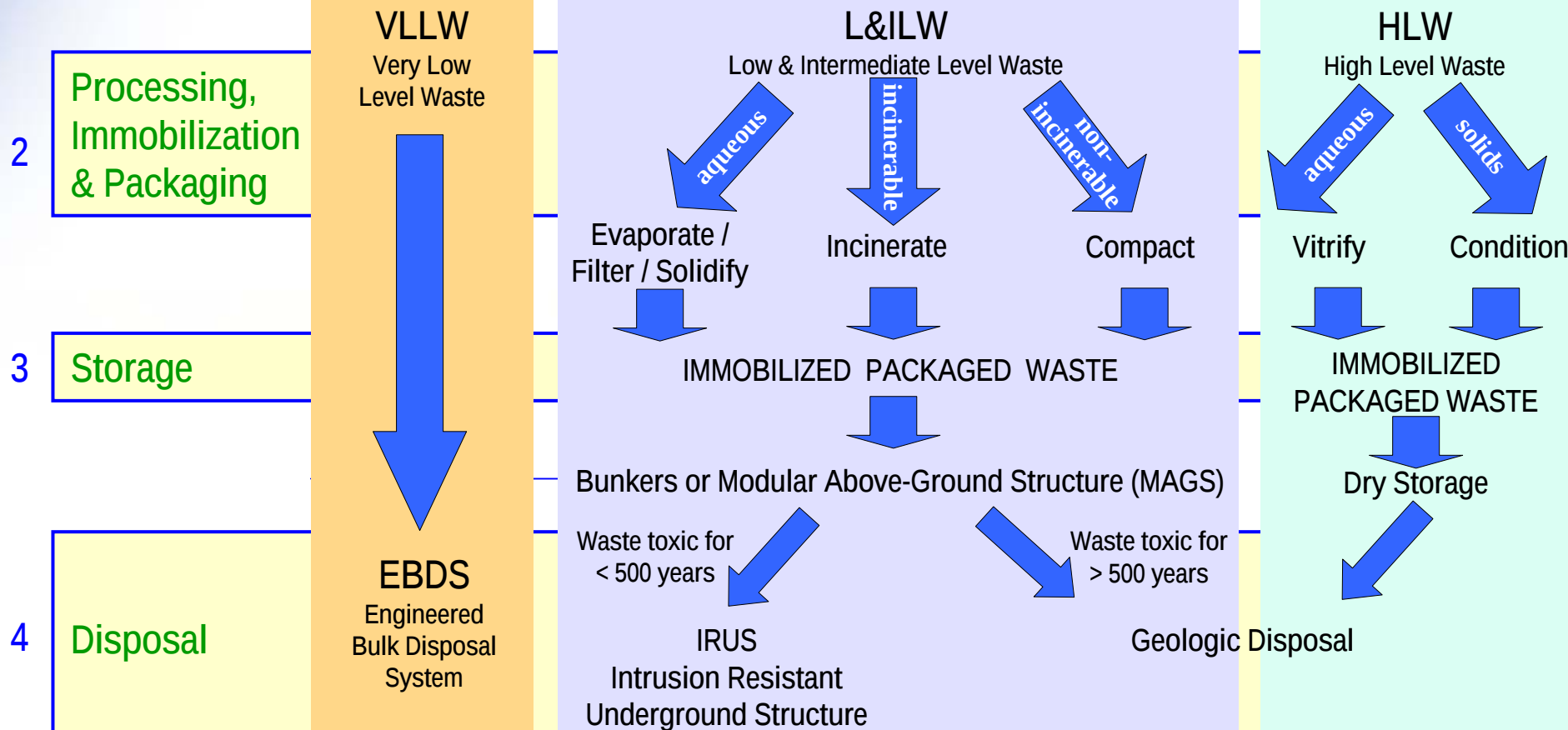




AECL's Waste Management Strategy: Four Steps

Generation: "Historic" Liabilities, AECL Lab Operations, Hospitals, Universities, Isotopes, ...

1 Characterization: Radioactivity, Physical, and Chemical Properties





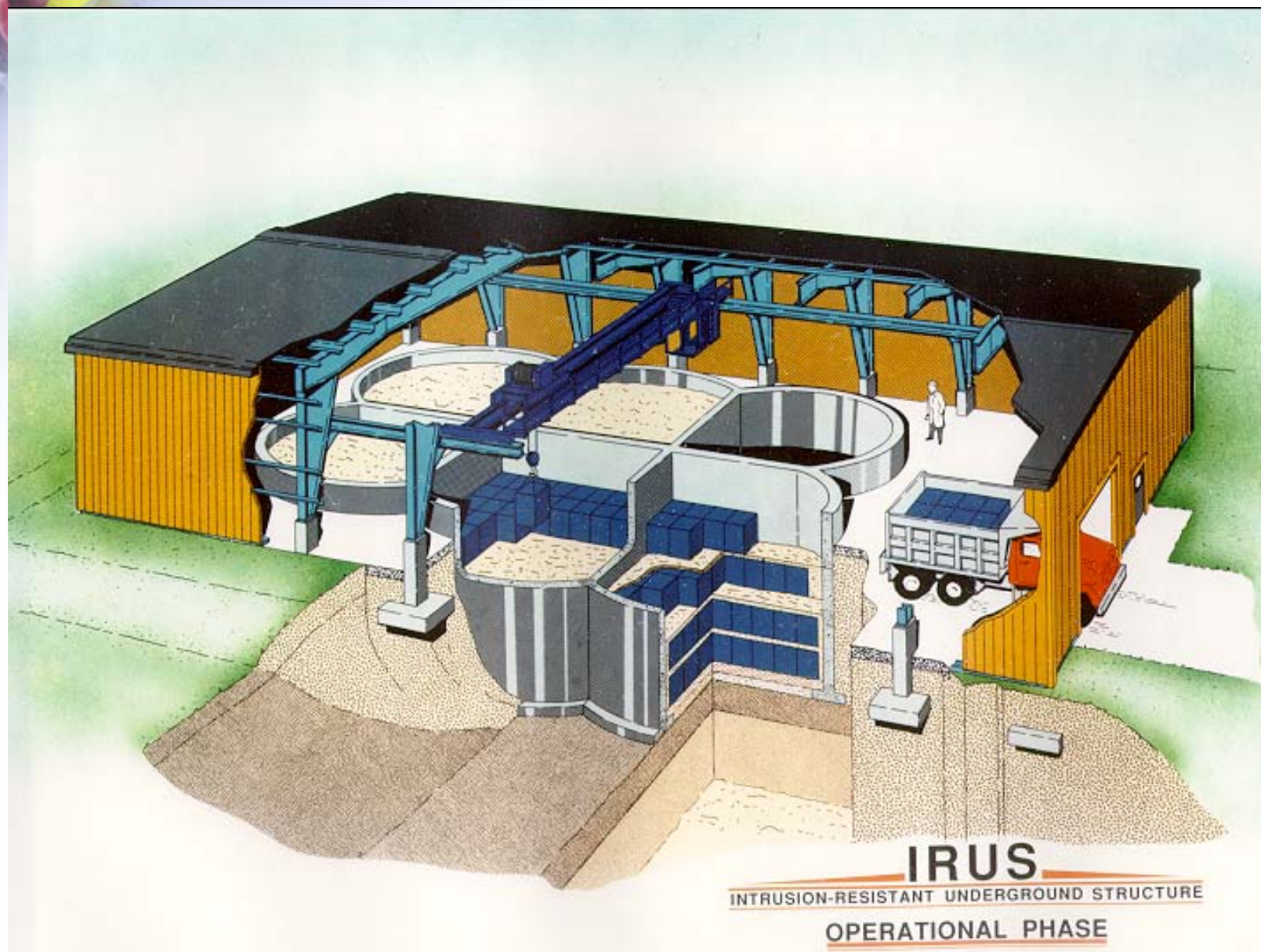
Decommissioning & Site Renewal Projects at CRL

- Stored Liquid Waste Remediation Project – Construct a new facility for consolidation of intermediate and high level liquid wastes (Phase 1), followed by immobilization (Phase 2)
- Tile Hole Waste Remediation Project – Construct a facility for conditioning historic research reactor fuels in historic standpipes (waste retrieval, stabilization, repackaging, and storage)
- Waste Treatment Centre (WTC) Upgrade Project – Improve reliability/availability of treatment facility for low to medium radioactive liquids produced at CRL
- Modular Above Ground Storage Project – Construct facilities for compacting and storing containerized solid low-level waste.
- Hot Cell Upgrade Remediation Project – Refurbish shielded facilities to support future decommissioning
- Active Drain System Replacement Project – Construct new piping network to route liquid wastes from nuclear facilities to Waste Treatment Centre



Waste Management Improvement Initiatives at CRL

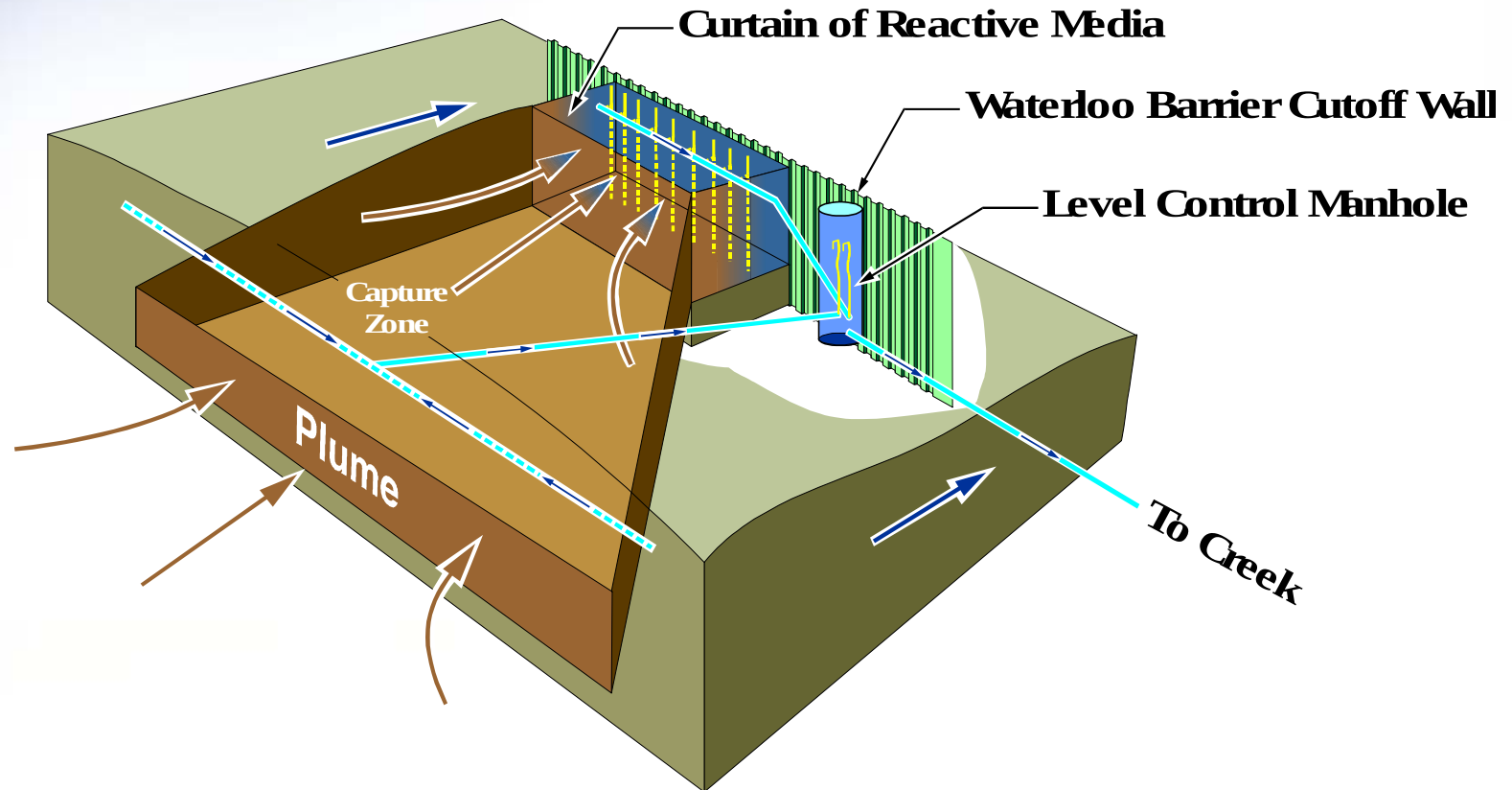
- Projects to improve current waste management practices and thereby reduce future waste liabilities:
 - Tile Hole Waste Replacement Packaging Project – for isotope production waste
 - Tank Replacement Project – characterize tank condition and needed actions
 - Thermal Waste Processing Options Study – for volume reduction of low level radioactive wastes
 - Intrusion Resistant Underground Structure (IRUS) Project – near-surface disposal of low level solid waste
- Projects to create infrastructure needed for decommissioning:
 - Tile Hole Investigation and Stabilization Project – fuel storage conditions and remediation
 - Waste Analysis Facility – characterize and separate contaminated/ non--contaminated wastes





Environmental Remediation Projects/Activities at CRL

- Collect and treat contaminated groundwater plumes by:
 - pump and treat systems (CHEMIC™)
 - “wall and curtain” system



Wall & Curtain Plume Mitigation



AECL Decommissioning Scope

Planning Envelope	Description
CRL Planning Envelope 1	Nuclear facilities listed on the CRL site licence
CRL Planning Envelope 2	Radiochemical laboratories and other buildings where radioactive materials have been or are being handled
CRL Planning Envelope 3	Low-Hazard nuclear structures
CRL Planning Envelope 4	Uncontaminated buildings (generally Supervised Area and Controlled Area 1)
CRL Planning Envelope 5	Distributed site services
CRL Planning Envelope 6	Affected lands on the CRL site (plumes, contaminated lands, contaminated landfills, sediments, abandoned facilities, waste outside WMAs)
CRL Waste Management Areas (WMAs)	WMAs A,B,C,D,E,F,G,H and Liquid Dispersal Areas
Off-Sites	NPD, Douglas Point, Gentilly 1
WL	Planning Envelopes 1,2,3,4 WMAs



Decommissioning Execution Stages

STAGES	KEY OBJECTIVES
INITIATE	• Vacate - Cessation of Operational Activities
Transfer Responsibility from	• Shutdown - Achieve Safe Shutdown State
Operations to Decommissioning	• Transfer - Transfer Facility to Decommissioning
DEFINE	• Assess Hazards and Risks
Assess Risks and Liabilities	• Estimate Liability Costs
CONTROL (ENABLE)	• Secure Regulatory Approvals
Establish Prerequisites for Physical Work	• Build Required Facilities (e.g., Enabling Facilities)
MITIGATE	• Achieve Sustainable Safe Shutdown State (SSSS)
Reduce Immediate HSE Risks	• Deactivation
	• Achieve Risk Reduction Objectives
REMEDiate	• Achieve Decommissioning End State
Remove Liability	• Decontamination, Dismantling, Disposal of waste



CRL Site Preliminary Decommissioning Plan

- Assumptions:
 - Nuclear operations will continue at the CRL site for the foreseeable future (new facilities will be constructed)
 - Timeframe for decommissioning the facilities that are now present on the site is approximately 70 years
 - A suite of enabling facilities is required for decommissioning to take place
 - Low-Level (and Intermediate Level) wastes will have disposal available ~2025
 - High-level wastes (used nuclear fuel) will be managed in accordance with NWMO plans (see later in this presentation)



Whiteshell Laboratories Decommissioning



Scope of WL Decommissioning

- “Listed” nuclear facilities
- Radioisotope facilities
- Radioactively contaminated buildings and services
- Inactive buildings and services
- Waste Management Area



WL Environmental Assessment

- Conducted at a “Comprehensive Study” level
- Findings of the Comprehensive Study Report (CSR)
 - Decommissioning is not likely to cause significant adverse environmental effects
 - Decommissioning is unlikely to produce any cumulative effects on the environment
 - Appropriate and effective public consultation was carried out
- Responsible authorities concurred with findings of the CSR
- Federal Environment Minister accepted the CSR findings on 2002 April 02



Approach to WL Decommissioning (1 of 3)

- Basic Rationale
 - Manage wastes within existing facilities for remaining facility life cycle
 - Move site wastes when disposal is available
- Assumptions about availability of waste disposal:
 - Low-level waste 2025
 - High-level waste 2055
- Goal is a decommissioned site in 60 years (~2060)



Approach to WL Decommissioning (2 of 3)

- Phase 1 (~ 6 years):
 - Decontamination, dismantling and modification to achieve a state of storage-with-surveillance
- Phase 2 (~ 10 years):
 - Waste management, including improvement initiatives for selected wastes in storage
 - Maintain storage-with-surveillance of facilities to be decommissioned



Approach to WL Decommissioning (3 of 3)

- Phase 3 (~ 40 years):
 - Initially, continued storage-with-surveillance
 - Then, final decommissioning of facilities and infrastructure
 - Removal of wastes from WL
- Final end state is “free release” of site, except for *in-situ* management of:
 - Low-level waste in trenches
 - River sediment contamination



Curent Status of WL Decommissioning

- The Canadian Nuclear Safety Commission (CNSC) issued to AECL a 6-year Decommissioning License effective 2003 Jan 01 for Phase 1 decommissioning of WL
- Phase 1 decommissioning activities are under way



“Offsite” Prototype Reactors



Decommissioning of the three AECL “Offsite” Prototype CANDU Reactors

- Preliminary Decommissioning Plans (PDPs) are to be submitted for all three sites within the next year
- Timing of decommissioning activities and end states will be aligned with intentions of the nuclear Utilities that share two of the sites
- Minimum 40 year storage-with-surveillance period before reactor core and internals are removed



Low-Level Radioactive Waste Management Office (LLRWMO)



Low Level Radioactive Waste Management Office

- Natural Resources Canada (NRCCan) conducts Canada's "historic" LLW management program through the LLRWMO



LLRWMO Activities





Port Hope Area Initiative (PHAI)

- The work involves the cleanup, storage and long-term management of 1.1 million m³ of LLW (mostly soil contaminated by refinery waste)
- The PHAI is expected to be undertaken in three phases:
 - Environmental Assessment (5 years, in progress)
 - Construction (~5 years, contingent upon regulatory approval)
 - Operation and monitoring



PHAI

- Considerable progress has been made in the last two years:
 - A legal agreement was signed with the three waste source communities (Port Hope, Hope Township, Clarington) in March 2001
 - A Property Value Protection Program has been established
 - A Stakeholder and community communications program has been established
 - The Environmental Assessment process is under way



Long-term Management of Canadian Nuclear Fuel Waste



Nuclear Fuel Waste Management

- Used fuel from all research and power reactors is stored in pools, casks, concrete canisters (“silos”), and AECL MACSTOR™ modules
- In the mid 1990’s, a Federal Environmental Review Panel examined AECL’s concept for geologic disposal of used fuel in the Canadian Shield, concluding that the technical case for the concept had been adequately demonstrated, but its acceptability to the public had yet to be demonstrated
- AECL continues to develop and demonstrate disposal technology for international clients and OPG:
 - Tunnel Sealing Experiment in the Underground Research Laboratory
 - Support to USDOE Yucca Mountain Project



Canada's Nuclear Fuel Waste Management Strategy

- Federal legislation (Bill C-27) created a Nuclear Waste Management Organization (NWMO) in November 2002
- The NWMO is a private non-profit corporation funded by the fuel waste producers (Nuclear Utilities and AECL)
- The initial mandate of the NWMO: assess options for long-term management of nuclear fuel waste, and recommend to the Federal Government a preferred method
- The fuel waste producers regularly send funds to a segregated account for the NWMO to use eventually to implement the selected concept



NWMO Recommendations

- Three approaches to long-term fuel waste management specifically listed in C-27 must be evaluated:
 - deep geologic disposal
 - storage at nuclear reactor sites (possibly with consolidation)
 - centralized storage (either above or below ground)
- Other options may also be evaluated
- The recommendation on the preferred approach are to be communicated back to the Minister of Natural Resources in 2005 November



NWMO Recommendations

The NWMO recommendations on the preferred approach, as required by C-27, must include:

1. Technical descriptions for implementation for each management approach considered
2. A comparison of the benefits, risks and costs of the approaches considered, as well as ethical, social and economic considerations
3. Funding requirements and an implementation plan for each management approach
4. Comments of the Advisory Council on the management approaches, and
5. A summary of comments received by NWMO as a result of consultations on each of the approaches with the general public and aboriginal peoples



NWMO Activities to Date

- Numerous public consultations have been held near each of the sites where nuclear fuel is currently stored
- Meetings have been held with the three utilities which have nuclear power generation (OPG, HQ, NBP) and AECL
- An expert workshop examining disposal alternatives was held
- Public comments are being collected via the nwmo website:
www.nwmo.ca



Status of D&WM in Canada

- The scope of decommissioning and waste management in Canada is very broad (multiple sites, buildings, prototype power reactors, affected lands, solid/liquid/hazardous wastes)
- Significant progress has been made in addressing health, safety and environmental risks and managing the liabilities, but continued concerted effort is required to further reduce Canada's historic and legacy liabilities
- AECL is working closely with the Federal Government and the NWMO to ensure an integrated plan is in place in Canada to address radioactive waste management and decommissioning aspects in a comprehensive manner

