Radioactive Waste Management

Offering Integrated Governance and Experience for International Nuclear Solutions

Tim Milner Atkins Fellow

Overview – About Atkins

Enabling a safe nuclear future through what we do today

Atkins is a global nuclear services company

- Integrated organization delivering regulatory services, technology, engineering operations, waste management, decommissioning and dispositioning solutions
- Primary customers include:
 - US Commercial, Government and Tier 1 contractors,
 - UK Commercial, Government and Tier 1 contractors,
 - AECL Canada,
 - International nuclear utilities such as:
 - Tokyo Electric Power Company
 - China National Nuclear Corporation
 - State Nuclear Power Engineering Corporation (China)



Complete Nuclear Services Organization

Our high caliber staff work with government and commercial clients worldwide to provide engineering, project management and site management solutions across the full lifecycle of the nuclear industry.



Innovative and Cost Effective Services Critical for Efficient Radioactive Waste Management

Facility Licensing Services

- Plant applications for site licenses
- Nuclear safety
- Quality Assurance
- Siting, environmental assessment and stakeholder engagement
- Regulatory consulting

Site Management & Operations

- Government and commercial nuclear operating sites
- Plant testing and commissioning
- Plant operation
- Training and readiness support
- Support of enabling technologies

Engineering

- Conceptual through detailed design across the full spectrum of disciplines, underpinned by applied technology
- Niche support in key areas of expertise: safety, fire protection, licensing, etc.
- Product and equipment supply
- Mobilization of multidisciplinary teams to provide owner engineer and architect engineer services

Regulatory Interface Drivers

- Understanding IAEA requirements
- Provide support to setting up, and implementing a regulatory framework
- Turn Key waste management facility design and construction which meets nations regulations in all aspects
- Support with in country approval and licensing

Project & Program Management

- Consulting services and program management teams to assist our clients to deliver controlled change to transform their businesses
- Comprehensive project controls capability including full suite of tools to support management and reporting of progress and performance
- Hands-on program and project managers, support functions and trusted advisors to support program governance
- Qualified project management consultants & practitioners



Our goal is to work with clients to understand waste management practices. Together we will develop a waste strategy, the necessary infrastructure framework and facilities, to solve near future challenges.

Understanding Nuclear Waste Management

Principles of Radioactive Waste Management

- Protection of human health
- Protection of the environment
- Protection beyond national borders
- Protection of future generations
- Burdens on future generations
- National legal framework
- Control of radioactive waste generation
- Radioactive waste generation and management interdependencies
- Safety of facilities

Facility Licensing Considerations

- Nuclear power plant needs
- Government regulation
- Localized regulation
- Transportation laws
- Geological and climate norm
- Environmental concerns
- Safety of workers and community
- Long-term vs. interim storage
- Facility, waste handling and transportation security
- Cost effective methods of treatment
 and disposal
- Defining waste characteristics
- Establishing disposal parameters such as waste acceptance criteria (multiple disposition pathways may be necessary for LLW, ILW & HLW)

Understanding Waste Challenges

There are many factors for consideration when determining the best strategy for radioactive waste treatment, conditioning, storage and disposition.

In this presentation we will cover the following topics:

- Waste Classification
- The waste management process
- Radioactive waste transportation
- Radioactive waste disposal





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Understanding Waste Manage

Committed to Technology

We deal with the technically complex challenges worldwide

Our technology portfolio supports asset management at nuclear facilities and waste management challenges across the globe





Characterization

Non destructive assay segmented and tomographic gamma spectroscopy, real time, radiography, neutron assay, XRF, XRD, SEM, FTIR Technologies

- Automated, remote sorting,
- breakdown and segregation systems
 - Process Gloveboxes

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Waste handling equipment



Treatment

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- Advanced liquid rad-waste processing systems
- Mobile liquid processing systems Polymer injection system to remove solids from liquid rad-waste
- Resin and filter dewatering system
- Reverse osmosis filtration

Cross-flow filtration

- Chemical, biochemical and mechanical decontamination
- Thermal Organic Reduction (THOR)
- Shredding and compaction
- Concentrate dryer

Immobilization

- Vitrification
- Geo-polymers
- Cementation and Grouting
- NOH20
- Waste from development & testing

Packaging Storage & Disposal

- Liners (steel and poly)
- Casks
- Radiation vaults
- Concrete boxes
- Container transfer systems
- High integrity containers
- Spent fuel shipping flasks
- Spent fuel dry storage systems
- ISESI construction

VTKINS

Bringing the Best Solutions Home

Finding the right strategy begins with understanding those practiced around the world.

Case Study:

Business Model Examination



Nuclear Business Model: US

Reactors are owned by private (commercial) utility companies



The business model in the United States places responsibility on privately held companies

- NRC licenses plant operations
- States implement special governance
- DOT governs transportation
- OSHA implements safety standards
- EPA governs environmental standards

Waste management, packaging, transportation and disposal is managed by private companies



Nuclear Business Model: UK

Reactors are managed by private (commercial) utility companies



The business model in the United Kingdom places responsibility on privately held companies

• ONR licenses and governs plant operations (including waste transportation & storage)

Waste management, packaging, transportation and disposal is managed by UK Government



Nuclear Business Model: China

Reactors are owned by China state utility companies



The business model in China places responsibility on private/state held companies

NNSA governs nuclear energy

Waste management, packaging, transportation and disposal is managed by government and private companies



Atkins Waste Management

Our mission is to improve the safety of nuclear materials handling through process management and innovative design.

Waste Management service offerings include:

- Engineering processing solutions for High, Intermediate and Low Level waste management
- Managing facility licensing (includes interfacing with Federal and State governing entities, communities and stakeholders)
 - Siting studies, regulatory management, safety assessment and design basis for waste processing plants, disposal facilities and infrastructure (transportation, containers, shielded casks, etc.)
- Managing the termination of site licenses
 - Environmental remediation activities in accordance with governing agencies

Case Studies: North America



Case Study: Chalk River We are part owner of the Canadian National Energy Alliance (CNEA), which was awarded as prime contractor to manage and operate Canada's AECL nuclear laboratories.

CNEA addresses key objectives for the government of Canada:

- Managing radioactive waste and decommissioning responsibilities at the Chalk River and Whiteshell Laboratories
- Establishing the entire waste management infrastructure for the site
- Ensuring nuclear science and technology capabilities and knowledge continue to support the federal government in its nuclear roles and responsibilities



Case study: Savannah River Waste Vitrification, US

We provide waste vitrification technology and related technical and engineering services to assist SRR with optimizing performance of the SRS Defense Waste Processing Facility (DWPF) and other waste treatment processes including:

- Enhancing the operational efficiency of DWPF and the LLW facility by applying proprietary technologies
- Improving DWPF's HLW feed preparation process so that it generates less hydrogen as the feed is being prepared. To reduce the amount of hydrogen generated during feed preparation, we are currently designing operational flowsheet changes to enable DWPF to reach its 400 canisters/year potential safely and consistently



Case study: Hanford Tank Waste Operations in support of the Waste Treatment and Immobilization Plant, US

We are part owner of Washington River Protection Solutions (WRPS), the prime contractor managing retrieval and transfer of liquid waste in the Hanford Site tank farms. The principal objectives of the contract are to:

- Develop and implement optimization of High Level Waste (HLW) retrieval, transfer, and conditioning
- Maintain and upgrade the infrastructure to enable HLW retrieval and transfer between tanks and to WTP
- Retrieve and evaporate liquids from the double-shell tanks (DST)
- Retrieve wastes from single shell tanks (SSTs) in preparation for closure
- Prevent Columbia River contamination
- Management of environmental, nuclear and criticality assessment



Case study: Big Rock Point Performed D&D at the 67 MW Big Rock Point Nuclear Plant under a fixed-price contract with Consumers Energy

- Management, handling, removal and disposal of app. 28,000 tons of material
- Design and licensed a 10CFR71 Type-B packaging system for road/rail transport and disposal of the reactor vessel
- The removal, packaging, transportation, and disposal of the 35-ton RPV Head

Case Studies: Asia Pacific



Case Study: Fukushima, Japan Dual train radioactive water treatment system capable of processing ~ 1500m3 (396,000 gallons) per day.

- Removes over 62 nuclides to below the limits of detection (Notably, levels below World Health Organization drinking levels)
- Cs-134/137 were reduced by over 5 orders of magnitude
- In some instances Sr-90 removal exhibited decontamination factors as high as 1 billion
- Developed HICs and storage techniques to mitigate hydrogen buildup
- Initial system, capable of processing ~ 750m3 per day, was designed and constructed in a matter of months in order mitigate further hazards under emergency conditions



Case Study: Haiyang Nuclear Power Plant, China

Design and build activities for a Site RadWaste Treatment Facility (SRTF) have been used at the Haiyang Nuclear Power Plant in Shandong Province, China since 2010. During this time, our team began work to design and build a system capable of handling the radiological waste treatment needs associated with the AP1000 reactor plant.

The entire work scope included the design, fabrication, installation and commissioning of:

- Site Rad-waste Treatment Facility (Includes waste reduction and storage capabilities)
- Facility licensing: PSAR, FSAR, Cask and High Integrity Containers (HIC)
- Nuclear Island mobile water treatment system, waste disposal equipment (HIC and dewatering system)



Case Study: Yangjiang Nuclear Power Plant, China

Yangjiang Units are Chinese CPR1000 PWR reactors. Atkins designed and supplied the liquid waste processing system (TEU) and complimentary solid waste systems (TES). The system will reduce the liquid effluent discharges to less than 1/2 of China's current national standard for inland reactor plants; meeting liquid discharge limits of >37 Bq/Liter.

- Worked within numerous regulatory requirements & various agencies
- Waste handling and management facility; includes reduction and storage capabilities.
- Facility licensing and management of licensing activities (PSAR, FSAR, Cask and HICs).
- Nuclear Island mobile water treatment system, waste disposal equipment (HIC and dewatering system).



Case Study: Rokkasho, Japan Atkins and the Vitreous State Laboratory Invented & Patented the Redistribution Method to Manage Yellow Phase glass Formation in support of waste vitrification at Rokkasho.

- Waste loading (the amount of radioactive waste by volume) increased from 21 wt% to 34 wt%
- Optimization increased by 60% Waste Processing Capacity;
- The new proccessing capability will save \$ Billions in Lifecycle costs



Atkins Liquid Radwaste Systems are capable of producing clean water to non-detectable radioactive levels



Case Studies: United Kingdom, Middle East and Europe



Case Study: Barakah, UAE Contracted by KHNP to design, manufacture, test, and supply the Liquid Radwaste Systems for BNPP Units 1&2 and Units 3&4.

Equipment consists of:

- Feed Control System
- Ozonation System
- Microfiltration System
- Ultrafiltration System
- Reverse Osmosis System
- Ion Exchange System
- Concentrate Feed System
- Sample System
- Control System



Case Study: Barakah, UAE Management Consulting - ESPS provided SME Team Support to Nuclear Atkins Assystem Alliance; sub-consultants to WS Atkins & Partners Overseas.

The team evaluated the following:

- Best Practice Benchmarking
- Retrospective Checklist/review of Supplied Components (ENEC)
- Procedure Validation/Quality Assurance
- Process Effective evaluations
- UAE Nuclear Regulator Interface
 assistance



Case Study: Magnox

While operating Magnox the site(s) Atkins established and implement programs dedicated to the safe processing and storage of LLW, ILW and HLW. Atkins also managed site operations at active nuclear power plants and sites undergoing decommissioning.

- Sludge waste retrieval, processing and packaging for storage
- Managed operating activities associated with power generation and decontamination and decommissioning projects
- Established waste management infrastructure including ILW, and HLW (SNF) going into storage or reprocessing
- Managed transportation and individual licenses associated with moving waste in the UK





AP 1000 Haiyang Site Radioactive Waste Treatment Facility (SFTF)

- On Site radioactive waste segregation and processing which is expandable based on volume
- Reduced operating costs verses baseline methods
- Reduced secondary waste improving economics of new nuclear power plant operations
- Training and turnover of facility for complete operation by Chinese client

Super-compactor room



Drum storage



Control room



Waste drum import/export



Lidding and decontamination





High Integrity Container storage



Drum sorting/pre-compaction



Truck loading bay

Rad Waste Management Technology



Liquid waste processing



De-watering





Melters (recycling metals)



Vitrification



Gloveboxes



Drum handling and radiation scanning



Super-compactor

Rad Waste Transportation and Containers





Fuel transfer cask



Steel liners



Concrete radiation vaults



Transportation by rail

Transportation by road



Transportation by water



Vitrified glass container



Poly liners



Shielded transfer box



Transfer casks for all waste classifications



Multiple large components transferred by barge

Waste Management Options

- Turn Key waste management facility design and construction which meets National regulations in all aspects
- Support with in country approval and licensing
- Proven construction and operations used world-wide
- Complete training and qualification program
- Expertise in long term storage and repository facilities
- Supporting nations to develop centers of excellence for radioactive waste processing and disposal



Above: Centralized disposal cell (near surface) for Class A, B &C waste

Below: Above ground interim spent fuel storage facility



Disposal LLW

Waste Acceptance Criteria (WAC) is defined by the disposal facility, and is based primarily on guidelines set by governing entities.

Operations at a landfill disposal facility will typically include three verification levels to ensure the WAC is within compliance:

- Basic characterization,
- Conformance verification,
- On site verification.





Backfill for voids

Thank you

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