SNC Lavalin / ATKINS Introduction

INPP - R3 OPTIONEERING, CONCEPT DESIGN AND EIAR DEVELOPMENT

Ignalina NPP
November 2018

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

SNC Lavalin & ATKINS

Infrastructure

Oil & Gas

Mining & Metallurgy

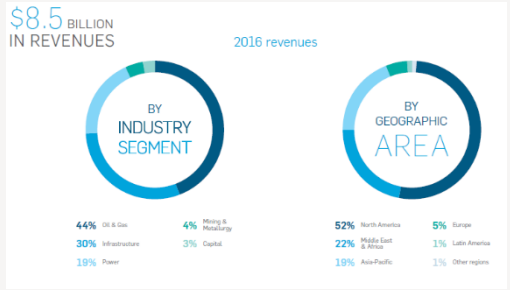
Power

APPROXIMATELY **50,000** EMPLOYEES

SPEAKS **70** LANGUAGES

WORK FROM OFFICES IN OVER **50** COUNTRIES

REPRESENTS SOME **130** NATIONALITIES



Consulting

Operation & Maintenance

Manufacturing & Project Management

Design & Engineering

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Atkins Energy Germany

ATKINS + ENERGY SOLUTIONS PP&T Group

SNC·LAVALIN + ATKINS

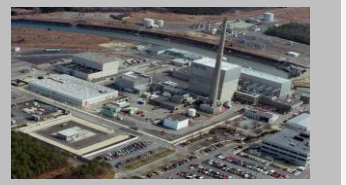
HOLTEC INTERNATIONAL + SNC·LAVALIN / ATKINS Member of the SNC-Lavalin Group

Atkins Energy Germany GmbH

Comprehensive Decommissioning International — A Holtec and SNC-Lavalin Company

NPP Pilgrim

NPP Palisades



NPP Oyster Creek

2016 — 2017 — 2018

SNC·LAVALIN ATKINS Member of the SNC-Lavalin Group

Major business lines in Nuclear

Nuclear New Build

- Original Equipment Manufacturer (OEM) for the CANDU® product range
- Project Planning & Licensing
- NSSS & BOP Preconceptual, Conceptual and Detailed design
- Engineering, Procurement & Construction (EPC)
- Supplier Qualification
- Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT) and Non-destructive Testing (NDT)
- Project Management
- Operator Training
- Commissioning

Nuclear Life Extension

- Major System, Equipment and Component Replacement
- Nuclear "N: stamp installation to ASME Boiler and Pressure Vessel Code
- Steam Generator Replacement (SGR)
- Project Management & Contractor integration
- Trades and Subcontractor management
- Remote-controlled Tooling Systems
- Tool Leasing and Servicing
- Upgrade, Uprate and Outage support

Lifecycle Services

- Operations & Maintenance (O&M) support for Water Reactor systems
- Design and Engineering support for Small Modular Reactors (SMR)
- Engineering Services
- Field Services
- OEM Spare Parts
- Legacy and Obsolete Part Manufacturing
- Repair, Remediation and Outage support
- Radiological Protection services
- Performance Improvement
- Staff Augmentation

Decommissioning & Waste Management

- Project Management & Integration
- Decontamination & Environmental Remediation
- Dismantling, Cutting & Vessel Segmentation
- Very Heavy Lift (VHL) specification and management
- Spent Fuel & Waste Management
- Waste Characterization, Volume Reduction and Packaging
- Storage and Transportation of Nuclear Material
- Scalable Turnkey Solutions

Tier 1 Lab Services

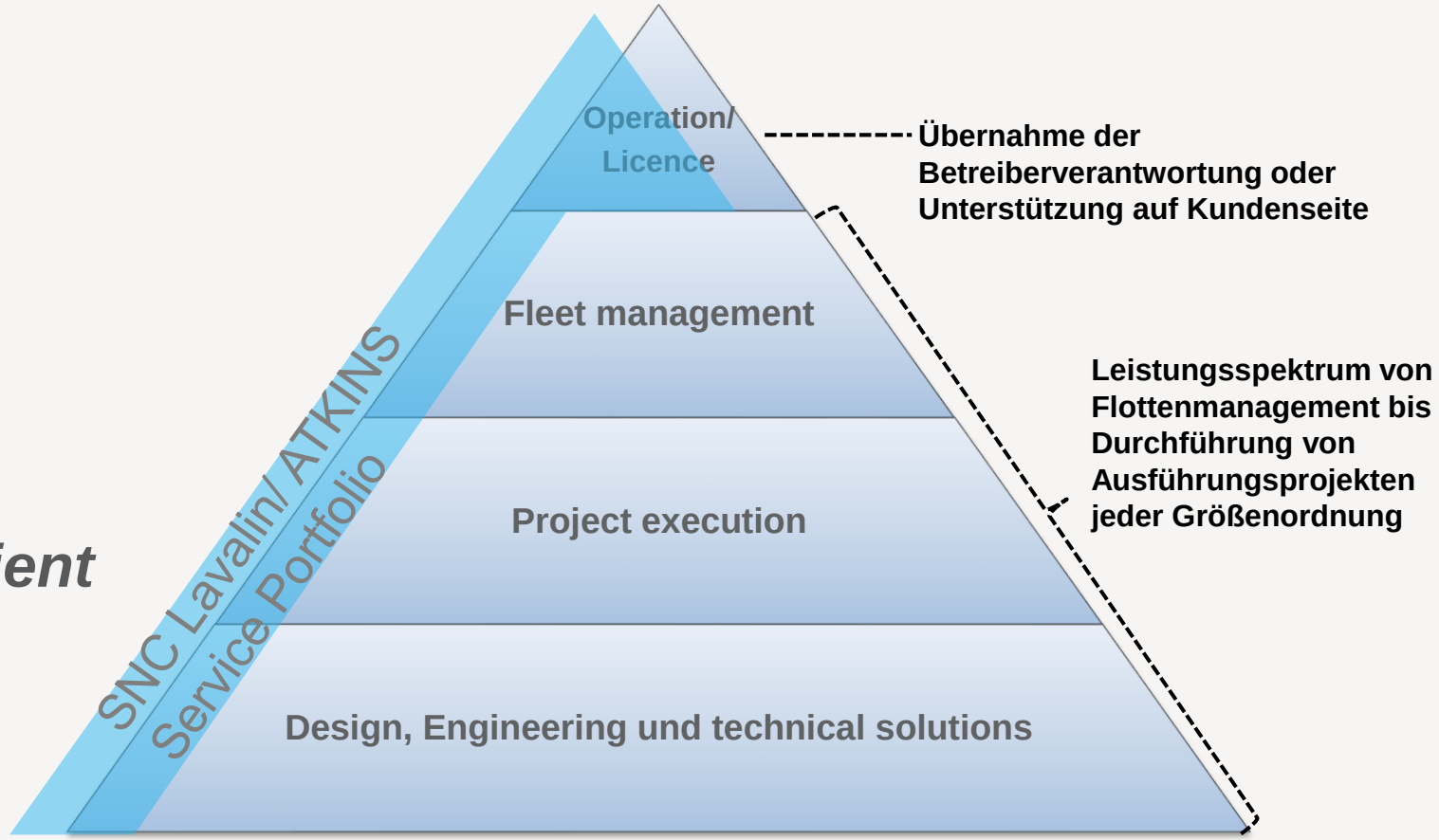
- Government owned, Contractor operated (GoCo) specialists
- Full lifecycle nuclear skill embedded capacity
- Suitable Qualified & Experienced Staff Augmentation
- Building and Facility rehabilitation
- Safety and Human performance recovery
- Fee at risk exposure
- Commercialization
- Asset Management
- Portfolio and Capital Project Management
- Communication, Software and Information security
- Procurement and Acquisition support

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Our services in Decommissioning

- ✓ Flexible contracting models
- ✓ Commited to ***Take Risk***
- ✓ Partnerships with Clients– ***Collaboration***
- ✓ Cooperation with regional Partners
- ✓ Project Execution with ATKINS: ***Safer, Faster & more efficient***



SNC·LAVALIN

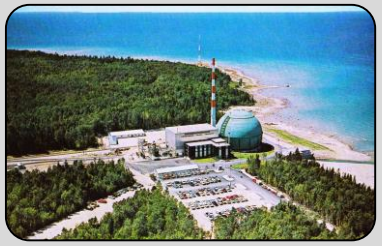
ATKINS
Member of the SNC-Lavalin Group

Decommissioning / SAFSTOR

Relevant Projects RPV segmentation SNC Lavalin & ATKINS

Connecticut Yankee

- Project execution 1999-2003
- Water abrasive cutting & metal arc
- ATKINS staff (Gary Bouchard) On-Site management & operations



Big Rock Point

- Project execution 1997 – 2003
- First deployment of MOTA – Equipment
- Mechanical cutting and plasma arc
- ATKINS staff executed the project (Pat Daly Project Manager)

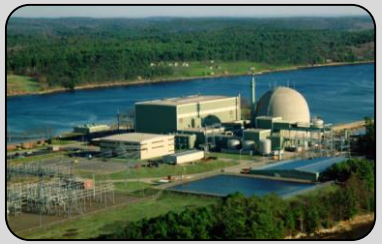
Yankee Rowe

- Project execution ca. 1993 - 1997
- Plasma, but later water abrasive cutting and mechanical
- RPV disposed of as a whole
- ATKINS (Brian Wood) involved in decommisioning planning (segmentation) & fuel management

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Relevant Projects RPV segmentation SNC Lavalin & ATKINS

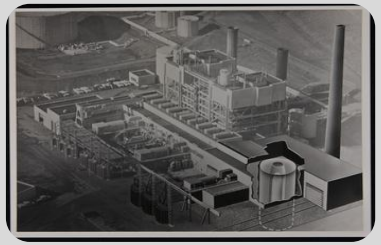


Maine Yankee PWR

- Project execution 2000 - 2003
- Water abrasive and metal arc (Framatome)
- Atkins staff (Art Palmer) managed packaging and transports
- ATKINS staff managed fuel operations (Brian Wood)

LaCrosse BWR

- Execution 2003-2007
- Removal /segmentation of the reactor pressure veessel internals



Humboldt 3 BWR

- Project execution 2008 – ongoing
- Segmenation by mechanical cutting equipment
- Dismantling delayed due to problems with mechanical equipment
- ATKINS staff involved in project management (Pat Daly) and RPV segmentation (Bill Hlopak)

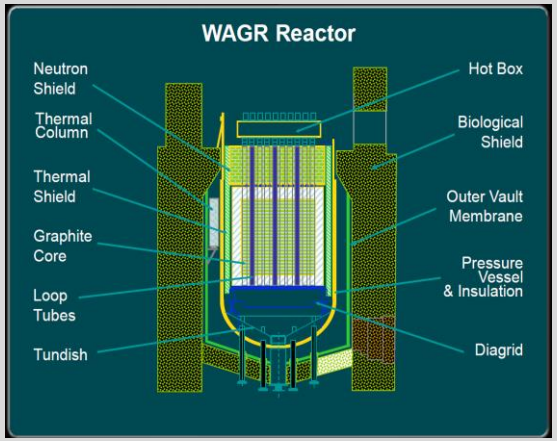
SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Relevant Projects RPV segmentation SNC Lavalin & ATKINS

Windscale AGR

- Removal of the „Hot Box“ – cylindrical vessel by plasma arc
- Loop Tubes (Stainless teel) grouted and then sheared
- Neutron shield & Grahpite Core -vaccum & magnetic grabbers, mechanical grabbers, drill/tap package were used to remove components
- Lower Structures & Core Support Plate – mechanical grabbers and oxy-propane



SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Waste Management

SNC Lavalin & ATKINS Waste Management Experience

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
- Waste handling equipment

Treatment

- Advanced liquid rad-waste processing systems
- Mobile liquid processing systems Polymer injection system to remove solids from liquid rad-waste
- Resin and filter dewatering
- Reverse osmosis filtration
- Metal Melt
- 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
- MACSTOR
- High integrity containers
- Spent fuel shipping flasks
- Spent fuel dry storage systems
- ISFSI construction

SNC·LAVALIN

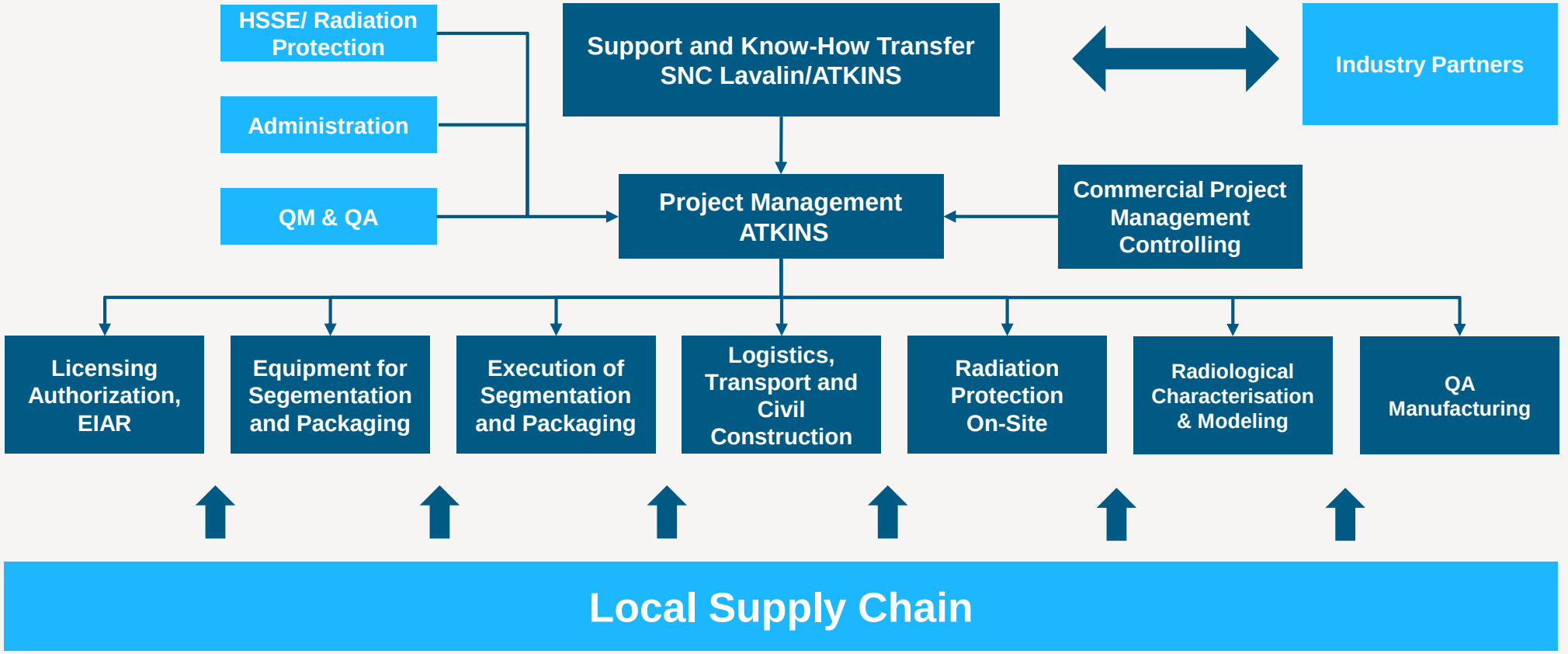
ATKINS
Member of the SNC-Lavalin Group

Our Approach to Reactor Dismantling

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Project Organisation ATKINS

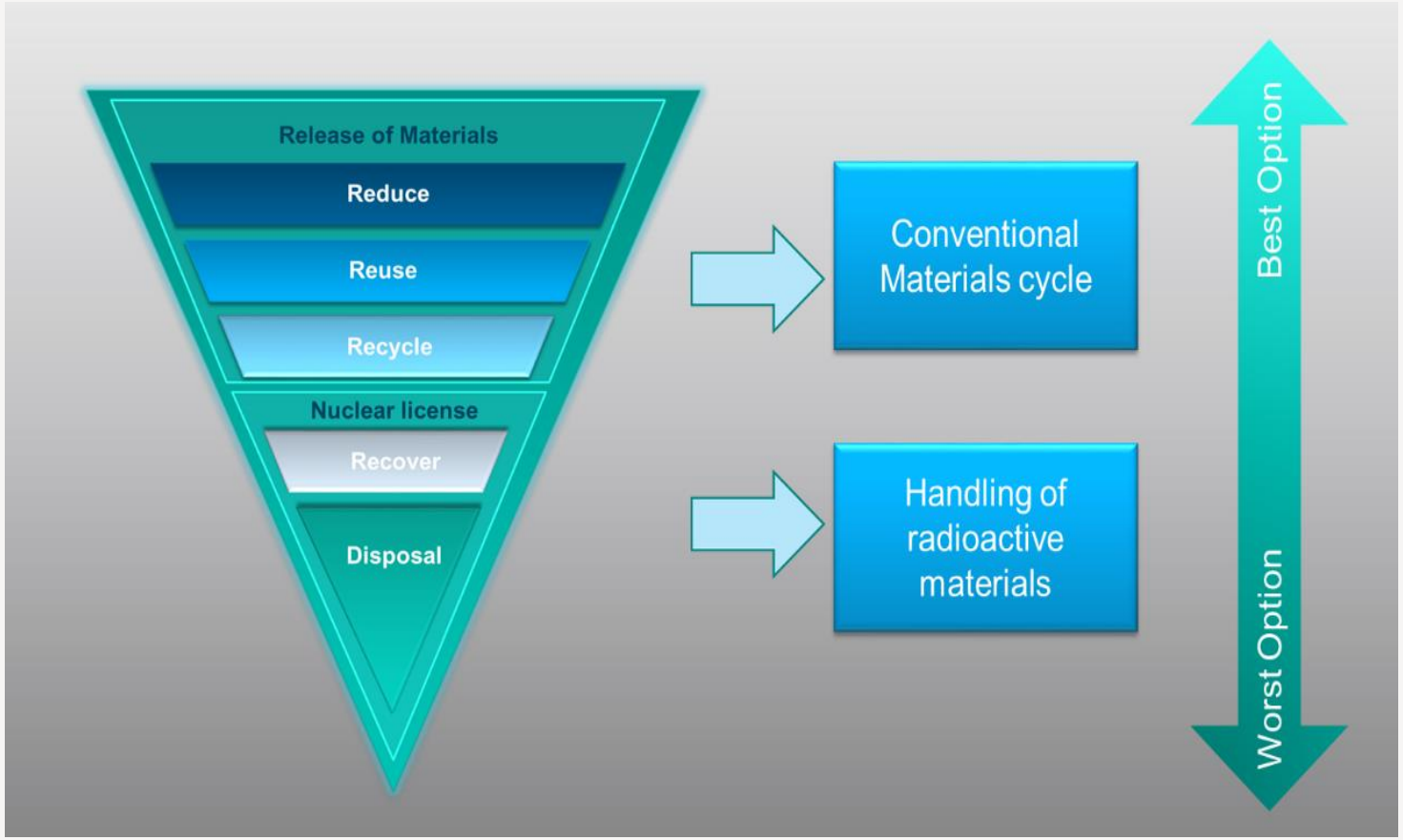


SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Waste hierarchy in reactor dismantling

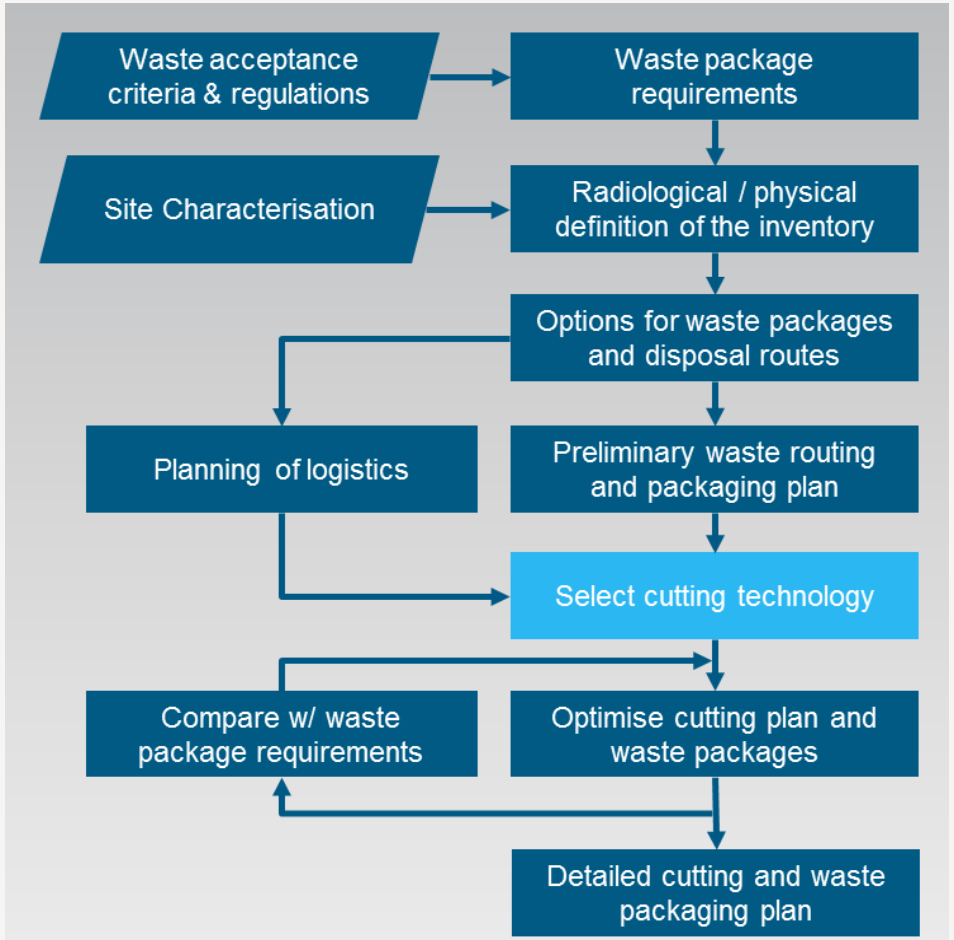
- Generally – drive material up the waste hierarchy
- Consider alternative waste routes is key (on-site/off-site)
- Value based approach to waste management
- Waste routing will drive the approach to segmentation



Segmentation and Packaging Concept

Design process

- Disposal and Packaging Requirements
- Inventory Definition
- Waste routes and Containers
- Preliminary Dismantling & Packaging Plan
- Selection of Dismantling Technology
- Optimisation of Dismantling & Packaging Plan



SNC·LAVALIN ATKINS Member of the SNC-Lavalin Group

Waste Management Concept – tailored solutions

Los N.	N. (Anhang 10)	Komponente	Behälter	Zeit T1	Jahr	Masse [kg]	Gewicht pro Container (A) [kg]	Limit 1	N. min. KC / Mosaik (Ahaus / Gorleben) T1	N. min. Container Konrad T1	Konrad T1			Uneing. Freigabe T1	EU Freigabe T1	Bear Creek T1	Siempelkamp T1
											Bgg	Ss	Sw				
1	16	RDG-DECKEL MIT FLANSCH M. PLATTIERUNG	KCIV-I-3-nst	43	2021	3,587E+04	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	JA	JA	FREI	FREI
3	5	RDG-BEREICH STUTZEN U. FLANSCH M. PLATTIERUNG	KCIV-I-3-nst	43	2021	4,787E+04	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	JA	JA	FREI	FREI
3	5	RDG-BEREICH WASSERABSCHEIDER M. PLATTIERUNG	KCII-I-2-nst	43	2021	1,722E+04	2114	ZWL begrenzt	8,1	1,1	JA	0,01356	0,00053	NEIN	NEIN	NEIN	NEIN
3	5	RDG-OBERER COREBEREICH M. PLATTIERUNG	KCII-I-2-nst	43	2021	1,273E+04	4080	ZWL begrenzt	3,1	1,0	JA	0,01346	0,00053	NEIN	NEIN	NEIN	NEIN
3	5	RDG-MITTLERER COREBEREICH M. PLATTIERUNG	KCII-I-2-nst	43	2021	1,169E+04	528	ZWL begrenzt	22,1	2,9	JA	0,01323	0,00052	NEIN	NEIN	NEIN	NEIN
3	5	RDG-UNTERER COREBEREICH M. PLATTIERUNG	KCII-I-2-nst	43	2021	9,401E+03	4079	ZWL begrenzt	2,3	1,0	JA	0,01347	0,00053	NEIN	NEIN	NEIN	NEIN
3	5	RDG-UNTERER STUTZENBEREICH M. PLATTIERUNG	KCIV-I-3-nst	43	2021	3,747E+04	-	V und m begrenzt	1,0	1,0	JA	0,00375	0,00025	NEIN	NEIN	JA	JA
3	5	STEUERSTABSTUTZEN	KCII-I-1-nst	43	2021	6,020E+02	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	JA	JA	FREI	FREI
2	27	STEUERSTABFUEHRUNGSROHR-KOPF	MOSAIK-II-st.fest	43	2021	2,750E+03	231	Konrad begrenzt	1,0	11,9	JA	0,01112	1,00000	NEIN	NEIN	NEIN	NEIN
2	27	STEUERSTABFUEHRUNGSROHR UNTEN	KCII-I-2-nst	43	2021	4,130E+03	-	V und m begrenzt	1,0	1,0	JA	0,00024	0,00001	NEIN	NEIN	JA	JA
3	3	STEUERSTABANTRIEBE	KCII-I-2-nst	43	2021	1,560E+04	-	V und m begrenzt	1,0	1,0	JA	0,00090	0,00004	NEIN	NEIN	JA	JA
2	20	KONDENSATRUEKL M D-LEITMANTEL	KCII-I-2-nst	43	2021	1,100E+03	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	NEIN	NEIN	JA	JA
2	19	DAMPFABSCHEIDER	KCII-I-2-nst	43	2021	8,960E+03	8952	ZWL begrenzt	1,0	1,0	JA	0,00769	0,00041	NEIN	NEIN	NEIN	NEIN
2	19	DA-MANTEL U ZYKLONUNTERTEILE	MOSAIK-II-st.fest	43	2021	4,610E+03	-	V und m begrenzt	1,0	1,0	JA	0,00775	0,78929	NEIN	NEIN	NEIN	NEIN
2	17	KERNDECKEL	KCII-I-2-nst	43	2021	3,990E+03	381	ZWL begrenzt	10,5	1,0	JA	0,00815	0,00042	NEIN	NEIN	NEIN	NEIN
2	17	SPANNRING	MOSAIK-II-st.fest	43	2021	7,000E+02	-	V und m begrenzt	1,0	1,0	JA	0,00119	0,12030	NEIN	NEIN	NEIN	NEIN
2	21	KERNMANTEL CORE OBEN	MOSAIK-II-st.fest	43	2021	1,760E+03	1152	Konrad begrenzt	1,0	1,5	JA	0,00947	1,00000	NEIN	NEIN	NEIN	NEIN
2	23	OBERES FUEHRUNGSGITTER	MOSAIK-II-st.fest	43	2021	8,490E+02	126	Konrad begrenzt	1,0	6,7	JA	0,01030	1,00000	NEIN	NEIN	NEIN	NEIN
2	22	SPEISEWASSERVERTEILERRING	MOSAIK-II-st.fest	43	2021	7,070E+02	-	V und m begrenzt	1,0	1,0	JA	0,00105	0,11149	NEIN	NEIN	NEIN	NEIN
2	22	SPEISEWASSERZUFUEHRUNG	MOSAIK-II-st.fest	43	2021	8,330E+01	-	V und m begrenzt	1,0	1,0	JA	0,00129	0,13701	NEIN	NEIN	NEIN	NEIN
2	22	ZUFUEHRUNGSANSCHLUSS	MOSAIK-II-st.fest	43	2021	5,050E+02	-	V und m begrenzt	1,0	1,0	JA	0,00075	0,07918	NEIN	NEIN	NEIN	NEIN
2	21	KERNMANTEL CORE MITTE	MOSAIK-II-st.fest	43	2021	2,040E+03	158	Konrad begrenzt	1,0	12,9	JA	0,00943	1,00000	NEIN	NEIN	NEIN	NEIN
2	21	KERNMANTEL CORE UNTEN	MOSAIK-II-st.fest	43	2021	3,260E+03	1144	Konrad begrenzt	1,0	2,8	JA	0,00947	1,00000	NEIN	NEIN	NEIN	NEIN
2	21	KERNMANTEL STUETZ U VERTEILR	KCII-I-2-nst	43	2021	3,810E+03	-	V und m begrenzt	1,0	1,0	JA	0,00001	0,00000	NEIN	NEIN	JA	JA
2	25	UNTERES FUEHRUNGSGITTER	MOSAIK-II-st.fest	43	2021	1,600E+03	232	Konrad begrenzt	1,0	6,9	JA	0,01121	1,00000	NEIN	NEIN	NEIN	NEIN
1	17	RDB STEHBOLZEN DECKEL	KCIV-I-3-nst	43	2021	5,750E+03	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	JA	JA	FREI	FREI
3	4	RDB ISOLIERUNG OBERE ZONE	KCII-I-2-nst	43	2021	1,333E+03	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	JA	JA	FREI	FREI
3	4	RDB ISOLIERUNG KERN-ZONE	KCII-I-2-nst	43	2021	1,333E+03	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	JA	JA	FREI	FREI
3	4	RDB ISOLIERUNG UNTEN	KCII-I-2-nst	43	2021	1,333E+03	-	V und m begrenzt	1,0	1,0	JA	0,00000	0,00000	JA	JA	FREI	FREI
2	1	Brennelementkästen (4)	MOSAIK-II-st.fest	43	2021	1,000E+02	-	V und m begrenzt	1,0	1,0	JA	0,00002	0,00508	NEIN	NEIN	NEIN	NEIN
2	11	Brennelementkästen (316)	MOSAIK-II-st.fest	43	2021	7,000E+03	-	V und m begrenzt	1,0	1,0	JA	0,00017	0,03713	NEIN	NEIN	NEIN	NEIN
2	13	Laufrollen aus Stellite	MOSAIK-II-st.fest	43	2021	1,000E+01	1	Konrad begrenzt	1,0	18,2	JA	0,02416	1,00000	NEIN	NEIN	NEIN	NEIN
2	14	Vergiftungsbleche (70)	MOSAIK-II-st.fest	43	2021	4,000E+02	-	V und m begrenzt	1,0	1,0	JA	0,00067	0,14523	NEIN	NEIN	NEIN	NEIN

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Cutting Technology (1/2)

We have extensive Experience with different

Cutting technologies & methods

Each Project is different

→ There is no „Gold Standard“ for the tools

Category	Segmentation	Advantages	Disadvantages
Mechanical	Circular Saw	Familiar, proven technology Machining chips are easy to collect Blades are relatively easy to replace Ability to cut complex cross section within range of tool	Large reaction forces require a heavier, more rigid tool frame Limited cut depth Blades are expensive Relatively slow cut rate
Mechanical	Reciprocating Saw (Siempelkamp style	Familiar, proven technology Machining chips are easy to collect Can cut very large and complex cross	Large reaction forces require a heavier, more rigid tool frame Blades are expensive
Mechanical	Band Saw	Familiar, proven technology Machining chips are easy to collect	Large reaction forces require a heavier, more rigid tool frame Relatively slow cut rate Blades are difficult to replace remotely
Mechanical	Milling Cutter	Familiar, proven technology Machining chips are easy to collect	Large reaction forces require a heavier, more rigid tool frame Limited depth of cut
Mechanical	Abrasive Water Jet	Small reaction forces Precise Minimization of dust and fumes Greatly reduces the requirement for off gas collection and processing Omni-directional cutting The cutting profile is only limited by the position control capability of the cutting arm assembly.	Generates large volumes of secondary waste (water and the abrasive) Slow cut rate

Cutting Technology (2/2)

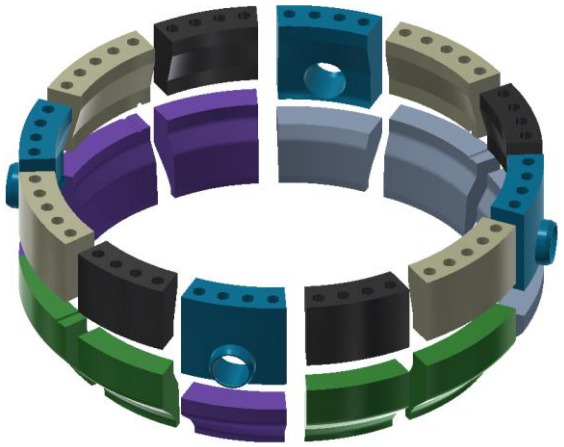
We have used

- Mechanical,
- WASS,
- Plasma,
- Oxy-Fuel and
- Laser cutting

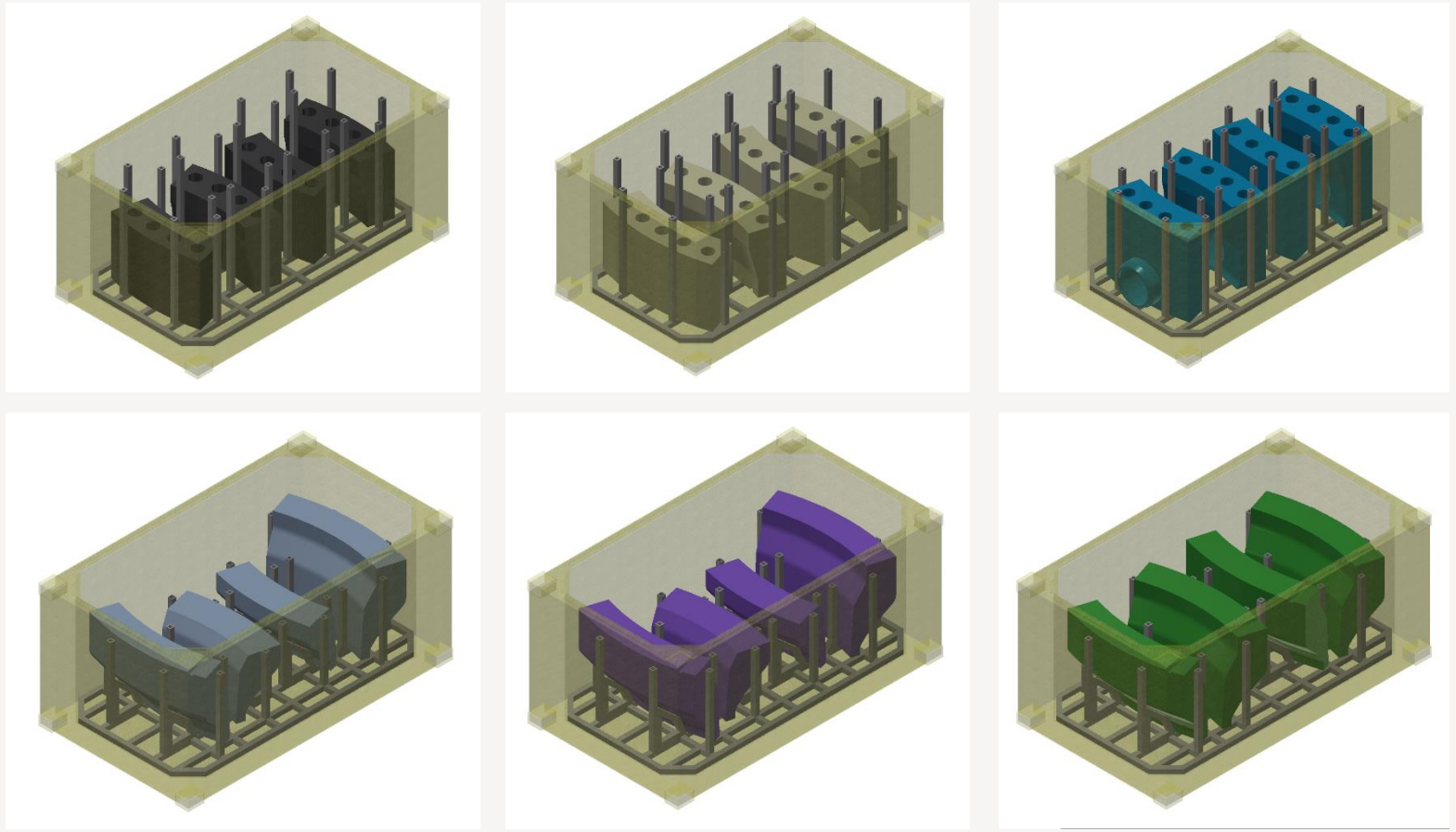
equipment in decommissioning

Category	Segmentation	Advantages	Disadvantages
Mechanical	Diamond Wire Saw	Well suited for solid material like concrete and heavy-walled structures Can cut very large and complex cross sections	Poor at cutting interrupted surfaces due to impact on diamond beads Difficult to start new wire in existing kerf following wire replacement Difficult to install new wire on tool Slow cut rate
Thermal	Plasma Arc	Familiar, proven technology Small reaction forces Fast cutting speed Plasma arc can be used on all conductive metals including stainless steel.	Requires elaborate containment and filtration systems Requires heavy surveillance for contamination control and fire hazards The chromium in stainless steel is not originally hexavalent, but the high temperature involved in
Thermal	Oxy-Fuel (Propane, Acetylene)	Familiar, proven technology High cut rate No reaction force	Requires elaborate containment and filtration systems Requires heavy surveillance for contamination control and fire hazards Oxy-Fuel does not work on stainless steel due to the very high melting temperature of chromium
Thermal	laser cutting	no reaction force, precise, laser unit can be operated in distance to the component to be cut (conducting fiber), distance to cutting surface not critical	First experiences in Sellafield and Winfrith, proven and efficient technology but less common in the nuclear decommisisoning field

Waste Packaging Examples (Germany)



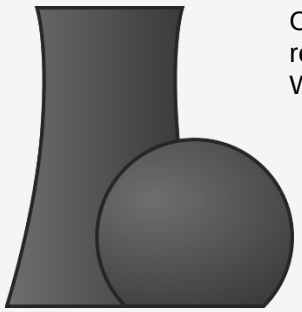
Disposal of RPV segments in KONRAD type IV Containers



SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

i-Graphite: a particular radioactive waste



Over 100 power reactors Worldwide

High diversity

MAGNOX
UNGG
AGR
HTR
RBMK
MTR

Management Options

1) Retrieval and Segregation
2) Characterization and Modelling
3) Treatment Options
4) Re-use and Recycle
5) Disposal Behaviour

- Main problematic activation products:
  - C-14 (typically 1-1000 kBq/g)
  - Cl-36 (very low activities)
- Classification as ILW (long half life)
- High biocompatibility / mobility of C-14

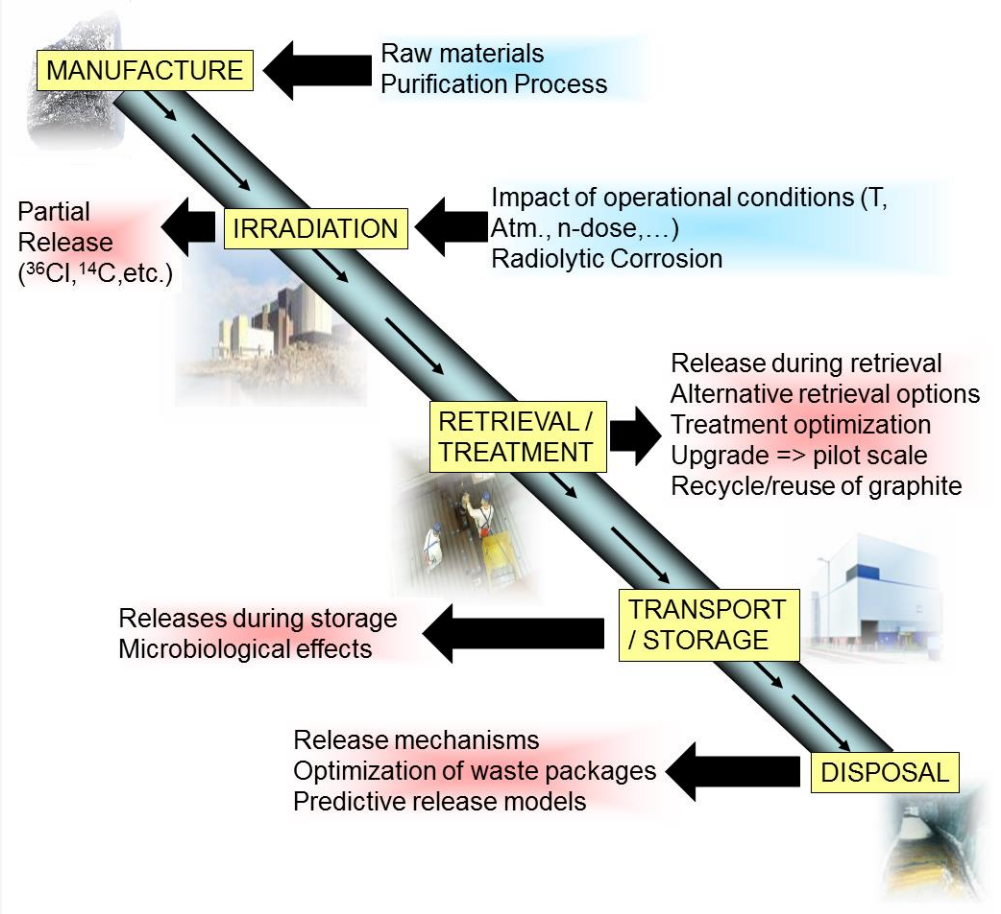
SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Factors influencing the behaviour of i-graphite

- Many parameters influencing the behaviour of i-graphite
- No standardized solutions/strategies adopted up to now, but in general
  - Waste acceptance criteria are the backbone
    - Konrad (Germany): volatile C-14 fractions strong limiting factor
  - Stabilization is possible by proper conditioning / treatment
  - No complete decontamination of long-lived RNs at the current stage
- EU Projects on i-graphite:

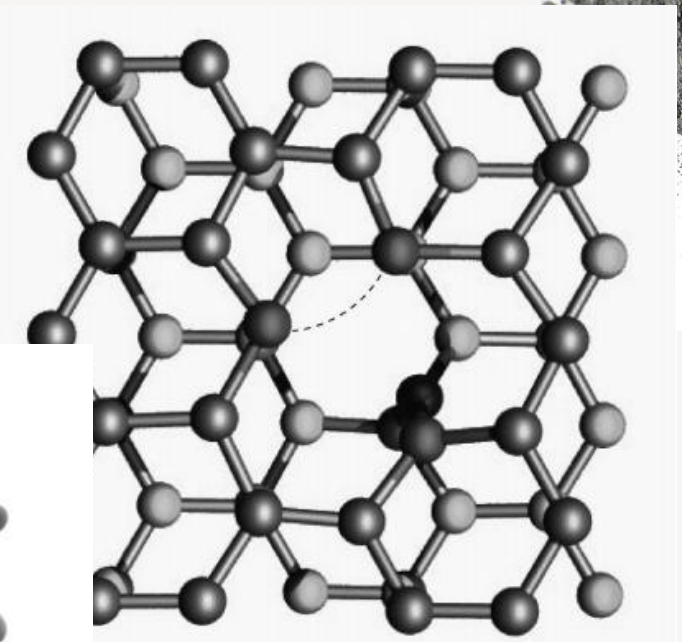
Carbowaste | CaST | GRAPA

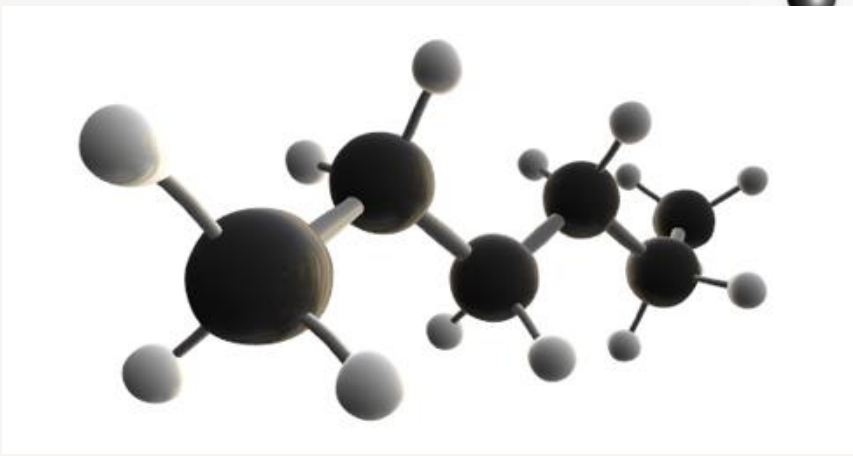


SNC·LAVALIN ATKINS Member of the SNC-Lavalin Group

Some possible issues with i-graphite

- Dust, especially during cutting
- Wigner energy
- Release of C-14 (also organic)





wels,R. H. Telling, A. A. El-Barbary, and M. I. Heggie,
able Frenkel Pair Defect in Graphite: Source of
Energy?" PHYSICAL REVIEW LETTERS, Vol. 91 n.
2003

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

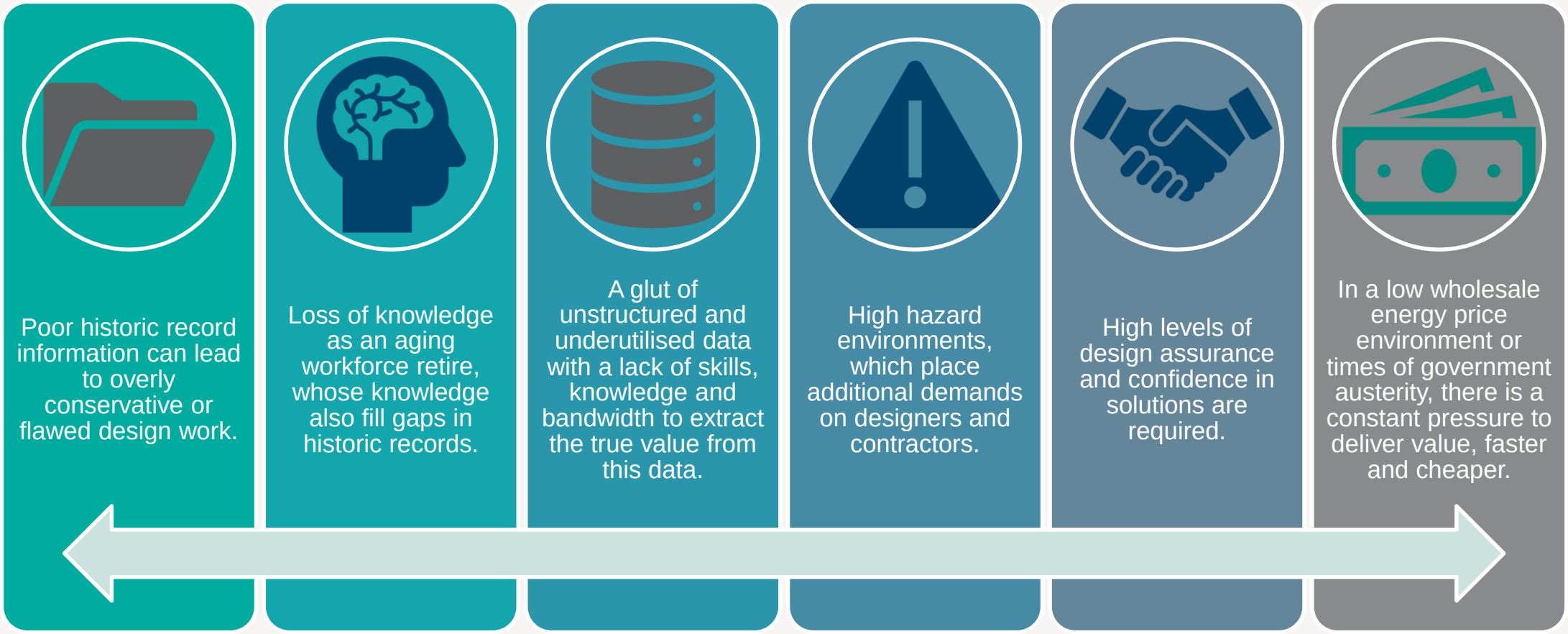
De-Risking Nuclear Decommissioning acitvities

An Introduction to our Digital Engineering Toolsets

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

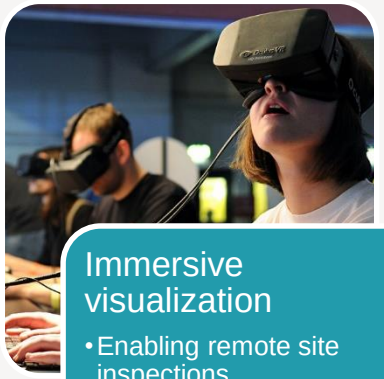
Digital journey
Common challenges amongst our clients



Digital journey
Moving forwards

Reality Capture

- Avoiding bad historic information
- Improving design quality and delivery
- Enabling model based definition



Immersive visualization

- Enabling remote site inspections
- Improved licence holder engagement
- Safer walkdowns
- New approach to HAZOP, Design Reviews, Stakeholder engagement

Digital Asset Management

- Providing a single source of truth
- Enable better information management
- Greater collaboration and sharing between stakeholders

Asset Performance Management

- Moving to predictive analytics
- Use of AI to spot trends for PSRs (LC15)
- Dynamic inspection analysis (LC28)

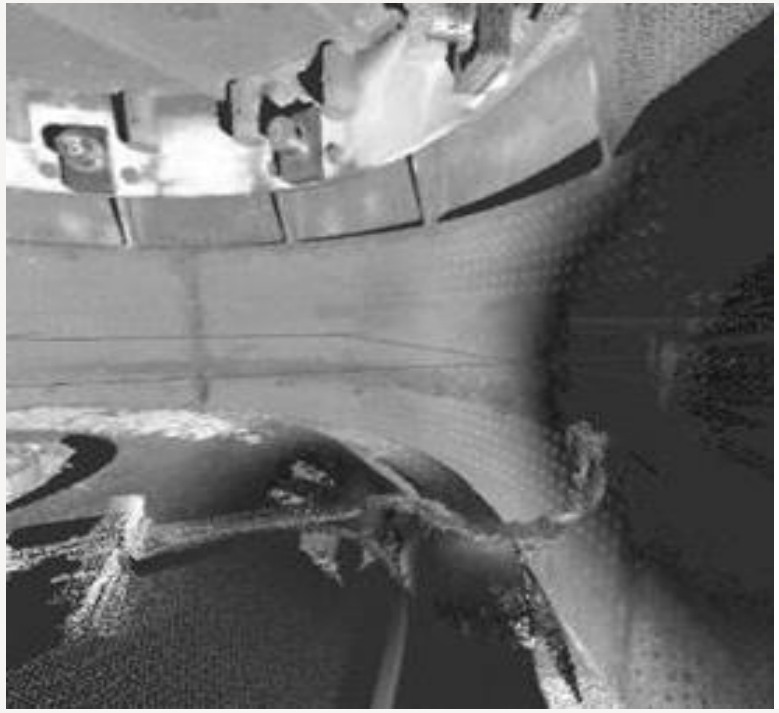
Recent project examples

SNC·LAVALIN

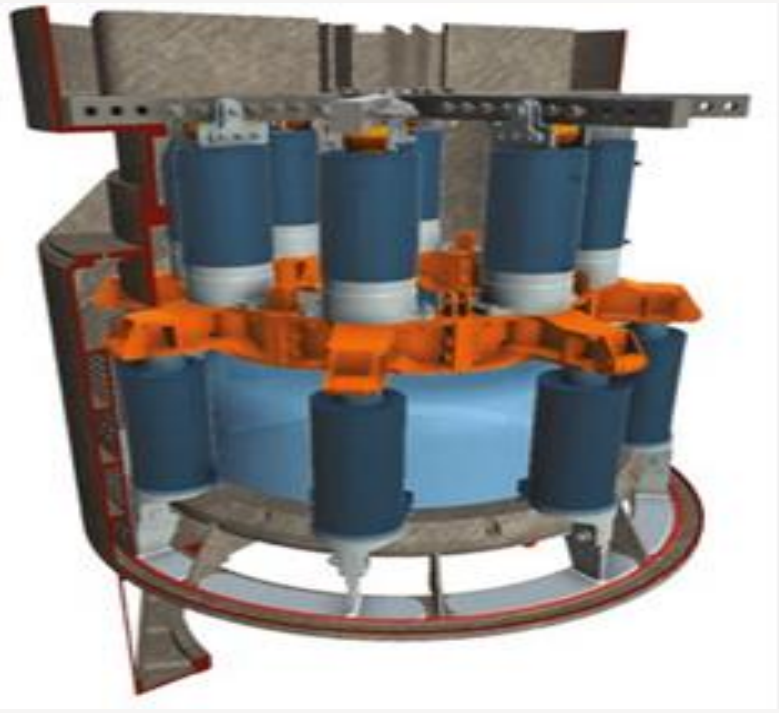
ATKINS
Member of the SNC-Lavalin Group

Heysham Maintenance

- Dose rates of >500µSv/h
- Scanning of Gas Circulators through 10x25cm opening
- All operations conducted during planned outage
- Safest, fastest and most cost effective way to capture on-site conditions

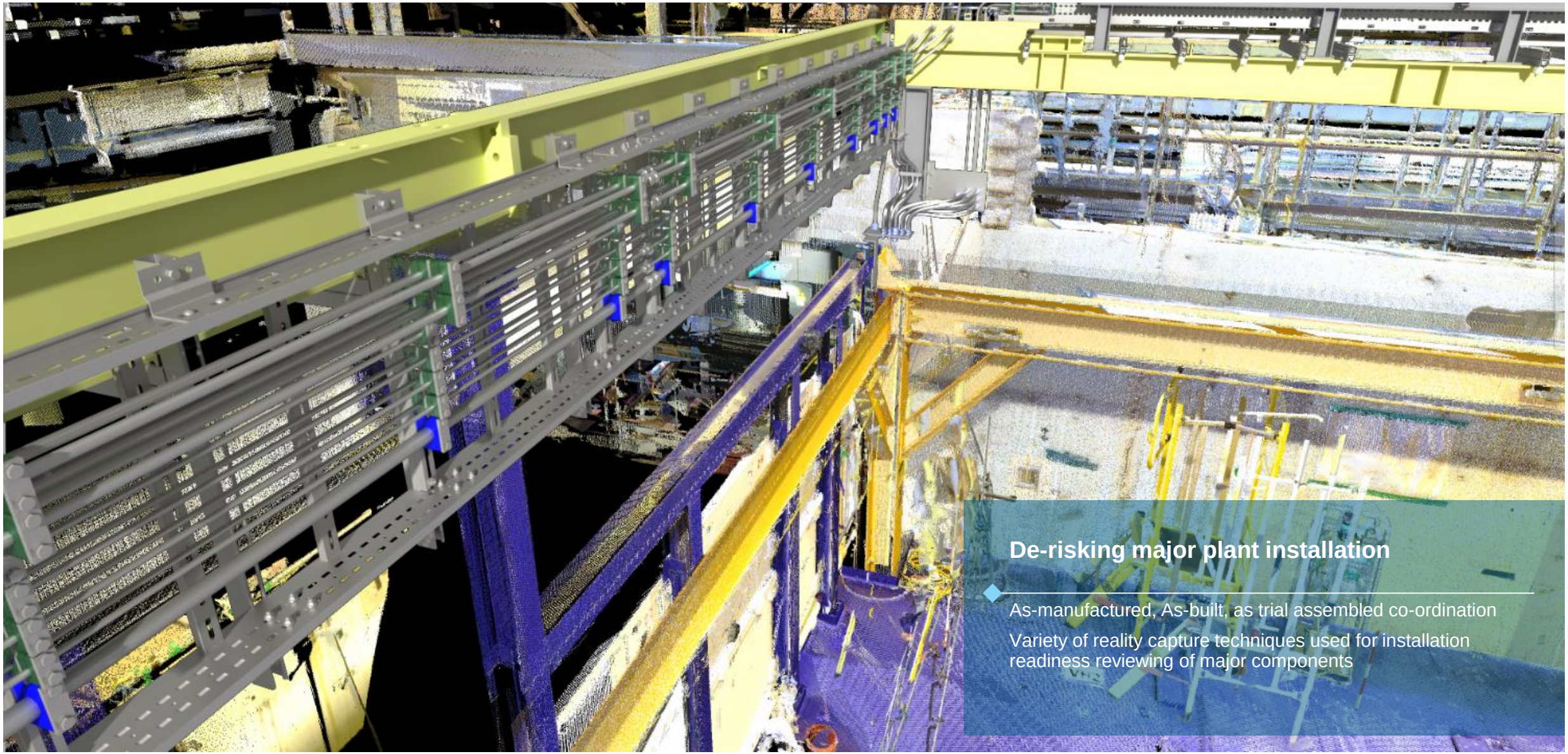


3D Scan of Gas Circulators in Heysham, UK (AGR)



Integrated design of new equipment in the scanned environment

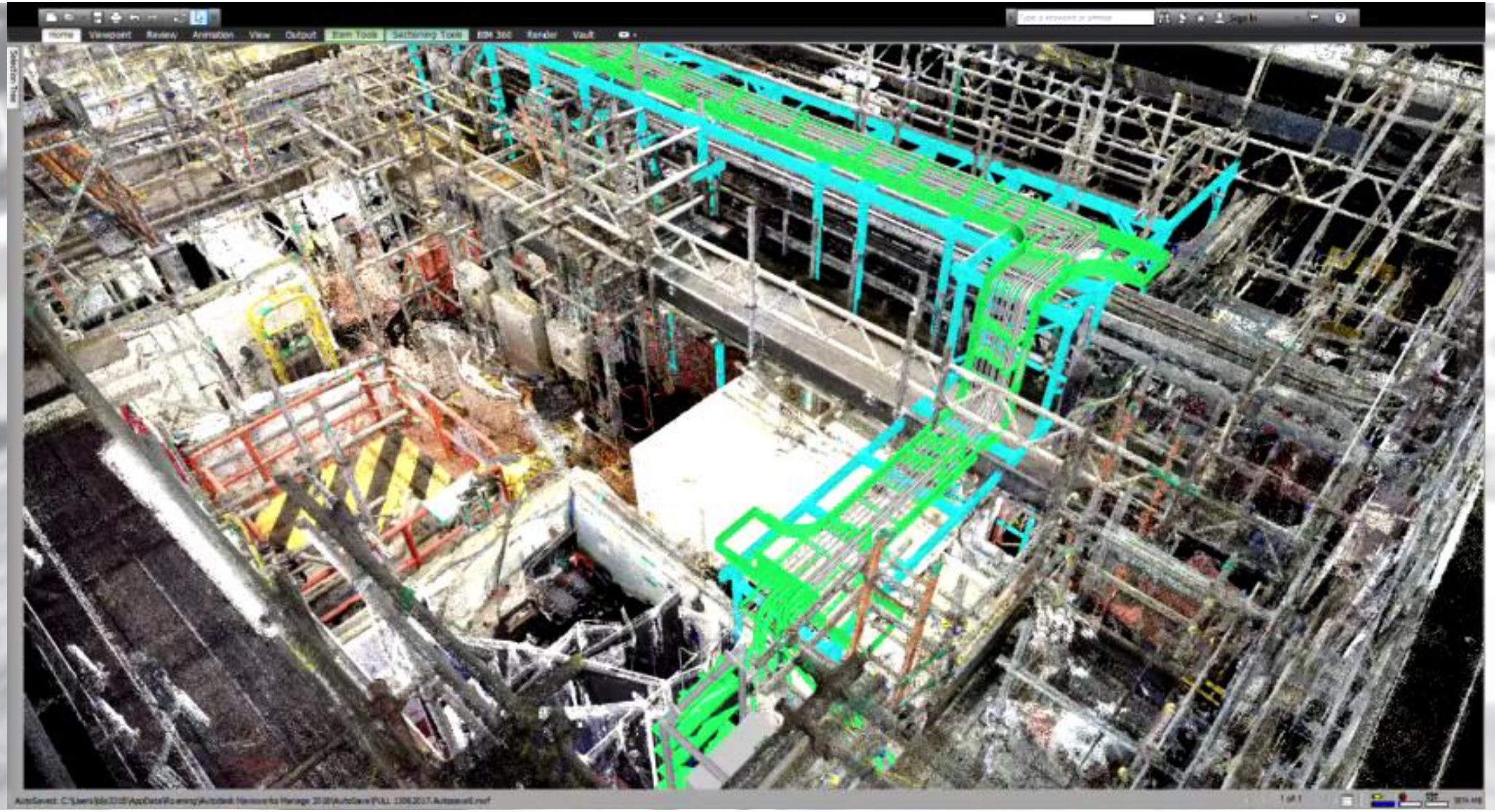
SNC·LAVALIN ATKINS Member of the SNC-Lavalin Group

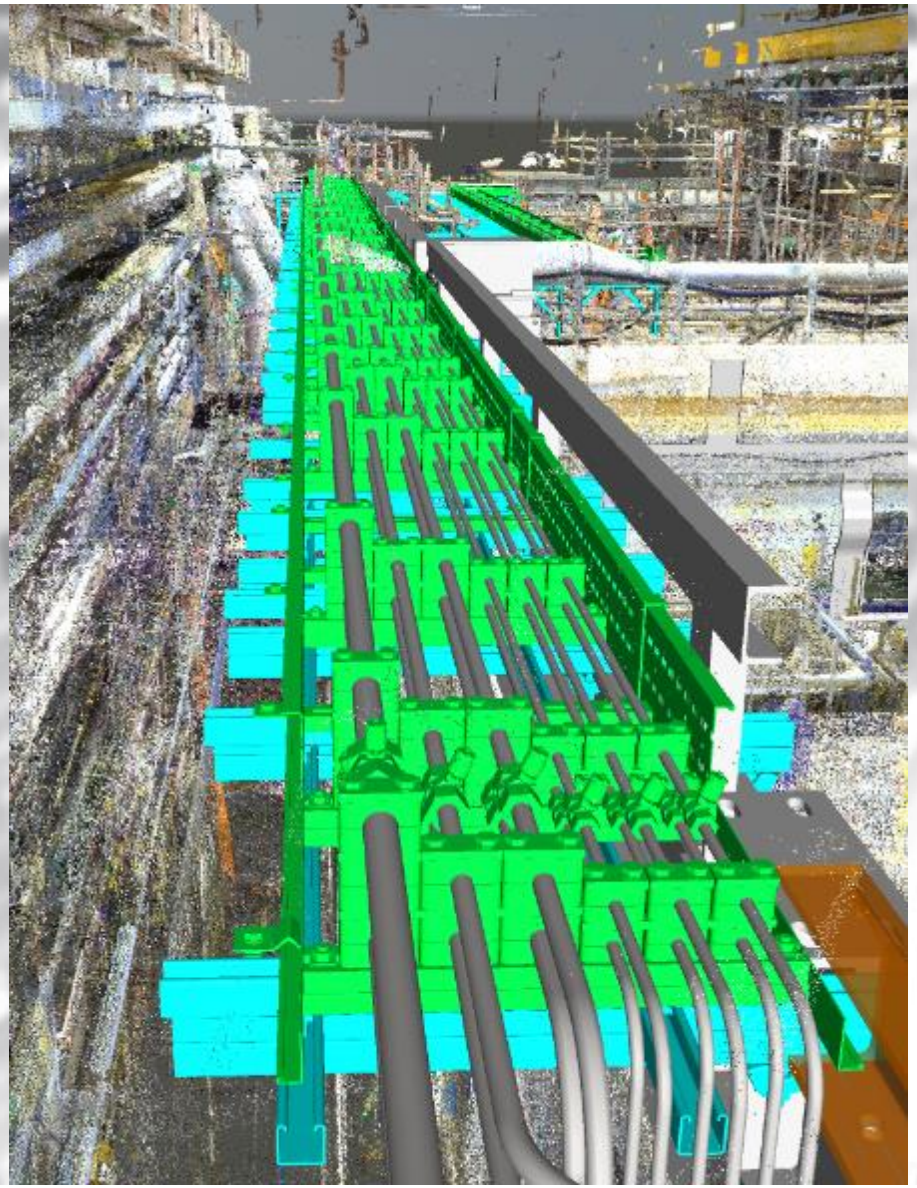


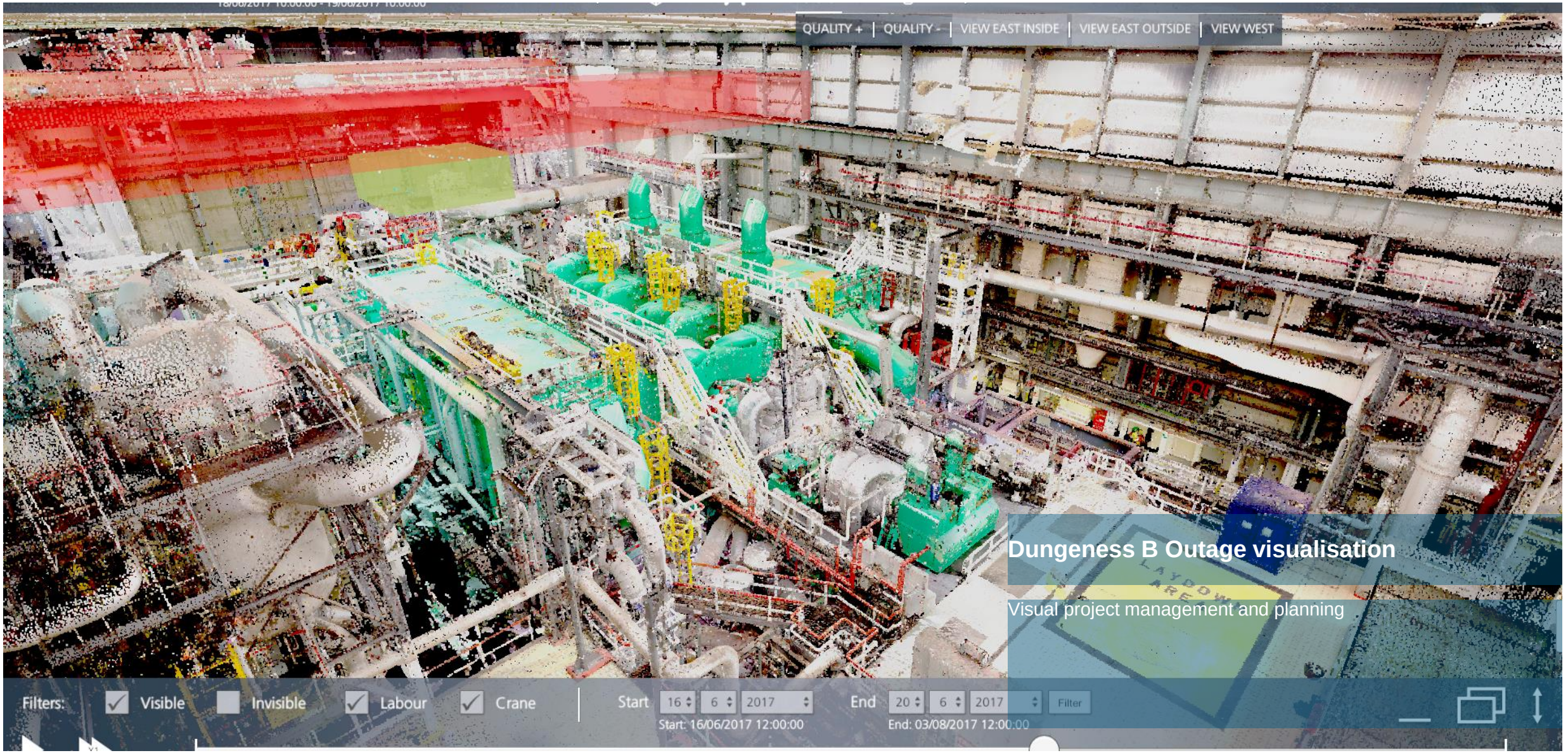
De-risking major plant installation

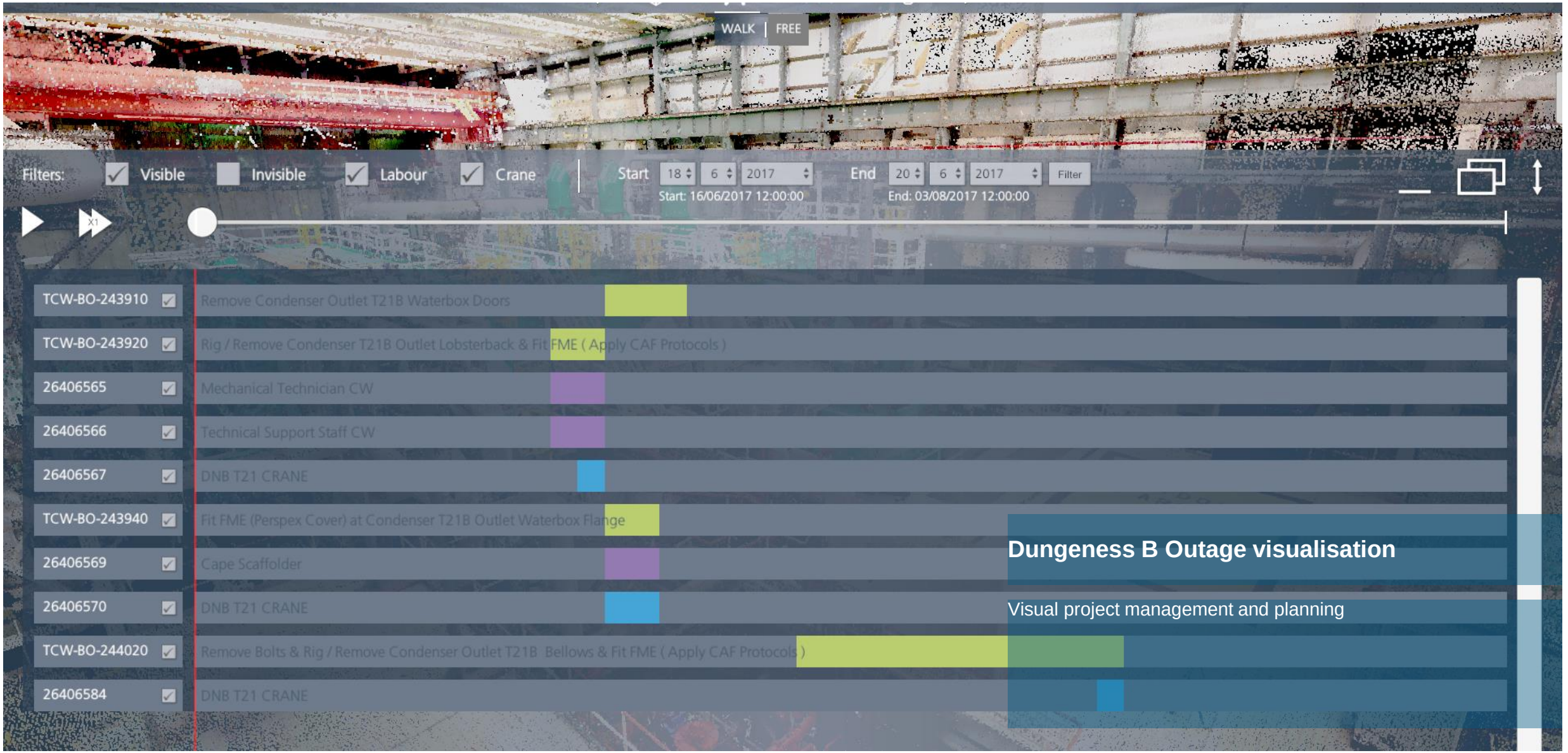
As-manufactured, As-built, as trial assembled co-ordination

Variety of reality capture techniques used for installation readiness reviewing of major components


Home
Viewpoint
Review
Animation
View
Output
Item Tools
Switching 1D/3D
BIM 360
Render
Vault




QUALITY + | QUALITY - | VIEW EAST INSIDE | VIEW EAST OUTSIDE | VIEW WEST
Dungeness B Outage visualisation
Visual project management and planning
Filters:
Visible
Invisible
Labour
Crane
Start
16
6
2017
End
20
6
2017
Filter
Start: 16/06/2017 12:00:00
End: 03/08/2017 12:00:00


WALK | FREE
Filters:
Visible
Invisible
Labour
Crane
Start 18 6 2017
Start: 16/06/2017 12:00:00
End 20 6 2017
End: 03/08/2017 12:00:00
Filter
X1
TCW-BO-243910
Remove Condenser Outlet T21B Waterbox Doors
TCW-BO-243920
Rig / Remove Condenser T21B Outlet Lobsterback & Fit FME (Apply CAF Protocols)
26406565
Mechanical Technician CW
26406566
Technical Support Staff CW
26406567
DNB T21 CRANE
TCW-BO-243940
Fit FME (Perspex Cover) at Condenser T21B Outlet Waterbox Flange
26406569
Cape Scaffolder
26406570
DNB T21 CRANE
TCW-BO-244020
Remove Bolts & Rig / Remove Condenser Outlet T21B Bellows & Fit FME (Apply CAF Protocols)
26406584
DNB T21 CRANE
Dungeness B Outage visualisation
Visual project management and planning

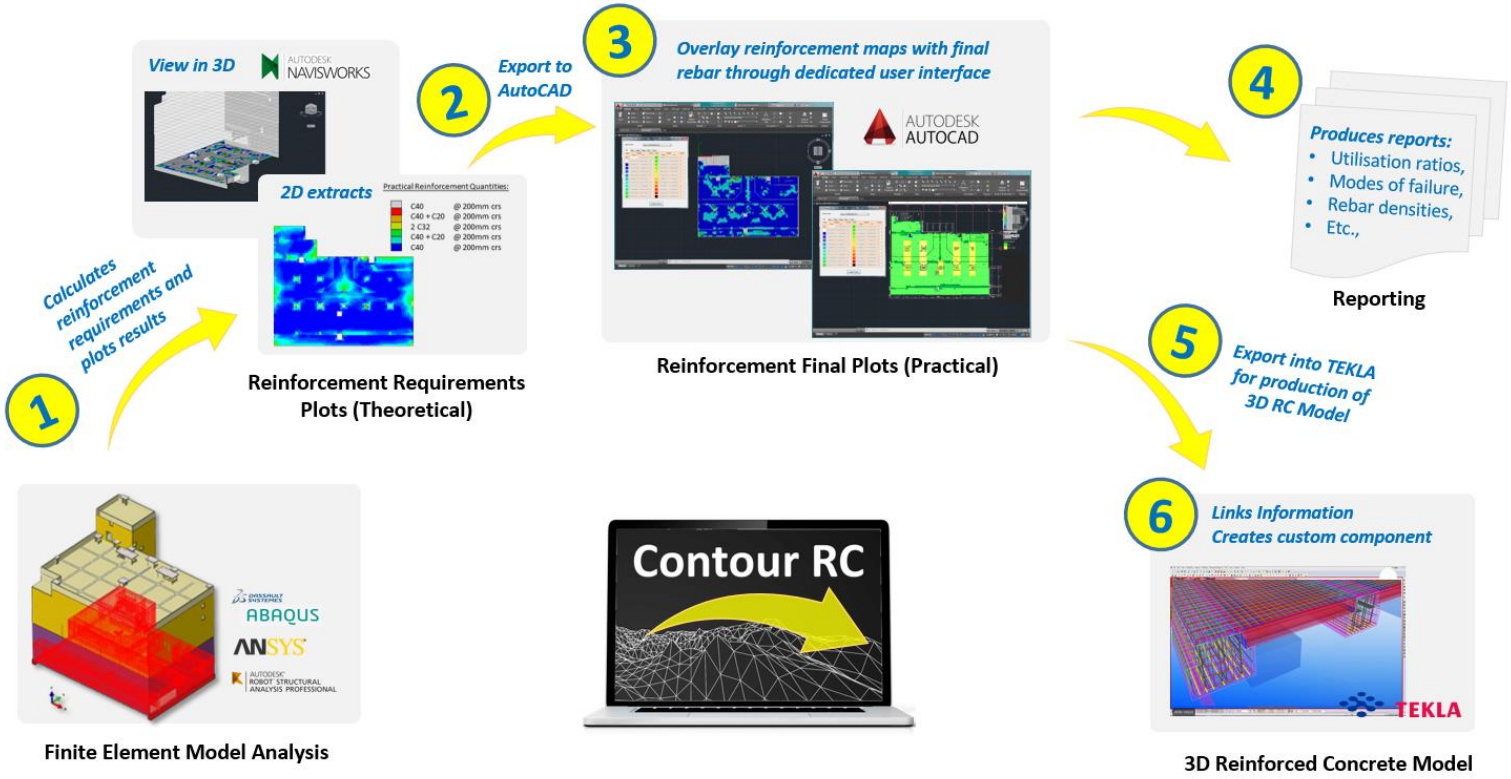
Our values are the essence of our company's identity.
They represent how we act, speak and behave together,
and how we engage with our clients and stakeholders.

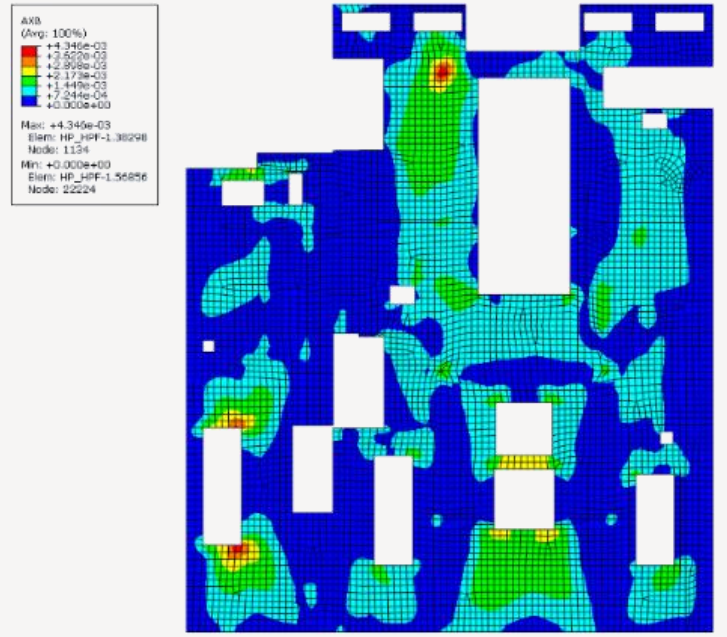
SAFETY	*We put safety at the heart of everything we do, to safeguard people, assets and the environment.*
INTEGRITY	*We do the right thing, no matter what, and are accountable for our actions.*
COLLABORATION	*We work together and embrace each other's unique contribution to deliver amazing results for all.*
INNOVATION	*We redefine engineering by thinking boldly, proudly and differently.*

Brownfield (as-built) asset management

Using digital scanning data for brownfield (As-built) asset management. Asset management data is displayed spatially though hotspots

Project: Calder Hall Turbine Hall A





- ✓ 1.1 billion calculations completed
- ✓ 100,000 reinforcement plots mapped
- ✓ Deliverable volume reduction: 10,000 pages → *150 files*

Automated Structural Design – ContourRC for HPC

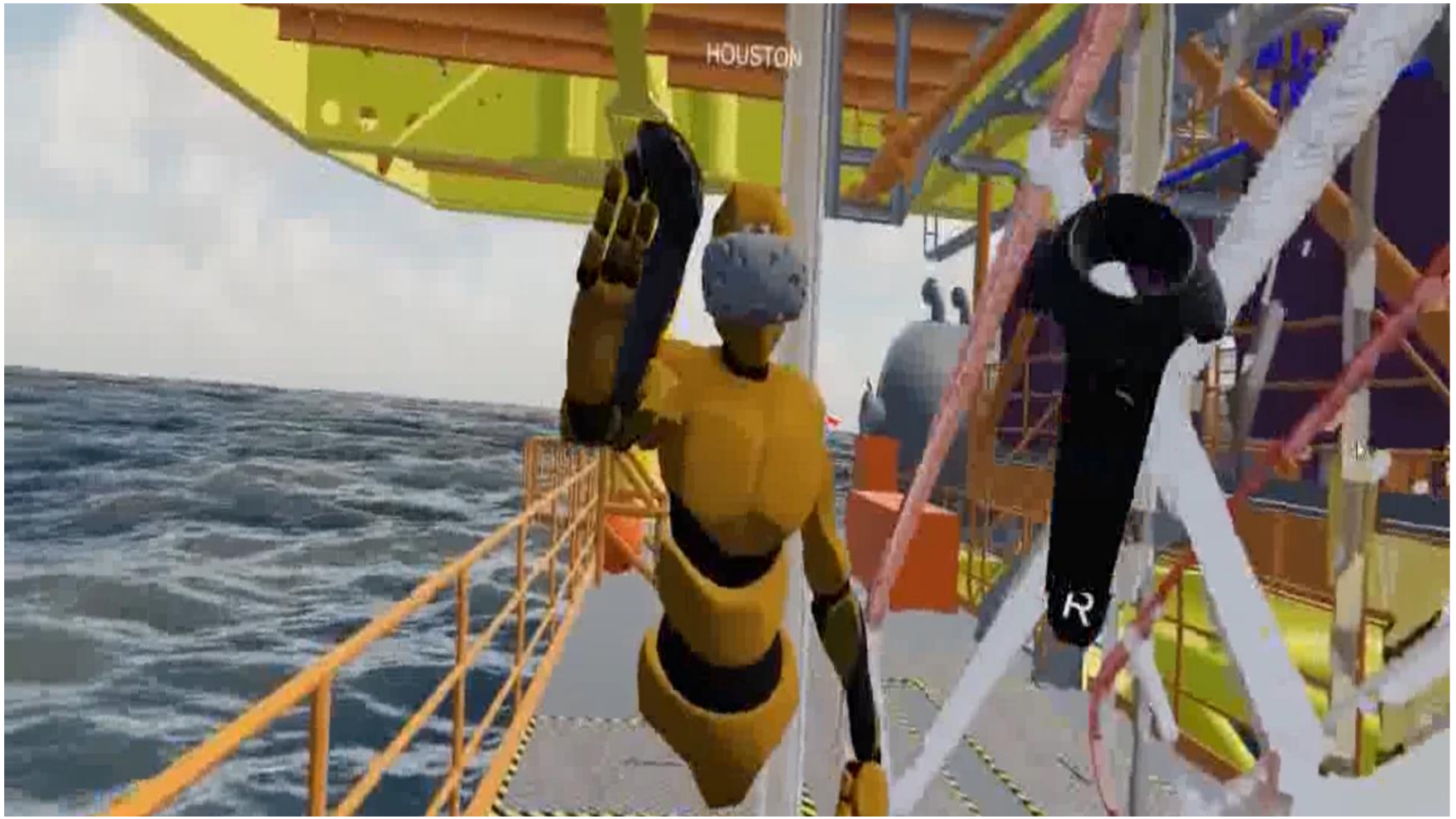
Demonstrated cost & programme savings of up to 50% with automated approach to structural design

Global design collaboration, leveraging scale and digital techniques to deliver savings

Contractors involved early in design stage, improving constructability

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group



Multiplayer VR

Enabling global collaboration in virtual reality

Hinkley Point C

Using Immersive visualizations, in particular VR, to interact with the 3D environment to make informed design decisions and enhance human factors assessment.

SNC Lavalin & ATKINS Waste Management Experience

Chalk River

Canada

50% owner of the Canadian National Energy Alliance (CNEA), which was awarded as prime contractor to manage and operate Canada's AECL nuclear laboratories.

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

Savannah River Waste Vitrification

United States

We provide waste vitrification technology and related technical and engineering including:

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

Hanford Tank Waste

United States

Part owner of Washington River Protection Solutions, prime contractor managing retrieval and transfer of liquid waste. Develop and implement optimization of High Level Waste retrieval, transfer, & conditioning

- Maintain and upgrade the infrastructure to enable HLW retrieval and transfer
- Retrieve and evaporate liquids from the double-shell tanks
- Retrieve wastesfrom single shell tanks in preparation for closure
- Management of environmental, nuclear and criticality assessment

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

SNC Lavalin & ATKINS Waste Management Experience

Fukushima

Japan

- Dual train radioactive water treatment system capable of processing ~ 1500m^3 per day.
- Removes over 62 nuclides to below the limits of detection
- 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

Haiyang

China

- Design + Build activities for RadWaste Treatment Facility have been used at the Haiyang Nuclear Power Plant in Shandong, China since 2010.
- The work scope included the design, installation and commissioning of:
- Site Rad-waste Treatment Facility Facility licensing: PSAR, FSAR, Cask and High Integrity Containers
- Nuclear Island mobile water treatment system,

Yangjiang

China

- Designed and supplied liquid waste processing system & complimentary solid waste systems .
- 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

Rokkasho

Japan

- In collaboration with Vitreous State Laboratory, invented & patented the Redistribution Method to Manage Yellow Phase glass formation in support of waste vitrification.
- Waste loading (the amount of radioactive waste by volume) increased from 21wt% to 34wt%
- Optimization increased by 60% Waste Processing Capacity
- New processing capability

SNC·LAVALIN

ATKINS

Member of the SNC-Lavalin Group

SNC Lavalin & ATKINS Waste Management Experience

Barakah

United Arab Emirates

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

Magnox

United Kingdom

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

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Scope in Nuclear back end

Pre-Planning

Client Side D&D Services

- Decommissioning Strategy Development
- Best Practice/Learning advice
- Regulatory Strategy development
- End-State planning and substantiation
- On-Site logistics planning
- Preliminary Decommissioning Baseline Production
- Integrated Decommissioning and Waste Management Planning
- Waste System/Facility Design
- Decommissioning Baseline Scenario/ Critical Path evaluations
- Independent Expert Review of strategies and plans
- Delivery Organisation Development
- Technology planning/evaluation
- Operation – Decommissioning Transition Planning
- Decommissioning & Waste Management Training and Development
- Safety Case Development
- Make & Buy Plan Development

Waste Services

- Facility/Waste characterisation
- Waste Facility Design
- Operational Waste Treatment
- Metal Melt, incineration etc

Defueling

Client Side D&D Services

- Regulatory engagement
- End-State Substantiation
- Execution Baseline Development
- Supplier engagement, evaluation and review
- Procedural changes
- Trusted Advisor resource support
- Organisational change facilitation
- Decommissioning Training and Development
- Project and Programme Management
- Waste Management Planning
- Rad-Protection Planning

Decommissioning Field Services

- Modifications to Site Access Arrangements
- Surface Stabilisation

Waste Services

- Facility/Waste characterisation
- Waste Facility Build (incl. Site Mods)
- Primary Circuit Decontamination (with Partner)
- Operational Waste Treatment
- Metal Melt, incineration etc

Transition

D&D

Client Side D&D Services

- Project and Programme Management
- Supplier Management
- Regulatory Engagement
- Trusted Advisor Resource Augmentation
- Waste Management Oversight
- Safety Case Development
- Rad-Protection Management
- Construction Management and Site Coordination

Decommissioning Field Services

- Large Component Removal (with Supplier/Partner)
- Reactor Segmentation (with Supplier/Partner)
- Facility Decontamination including concrete removal

Waste Services

- Facility/Waste characterisation
- Waste Operations
- Plug & Play Technologies e.g. ALPS
- Metal Melt/Recycling and Re-Use (through partners)
- Waste sorting/segregation (through partners)
- Incineration (through partners)
- Mechanical and Physical Decontamination (through partners)
- Operational Waste Retrievals
- Waste conditioning and packaging
- Waste Package verification

Site Restoration/Release

Client Side D&D Services

- Project and Programme Management
- License Termination
- Supplier Management
- Regulatory Engagement
- Trusted Advisor Resource Augmentation
- Waste Management Oversight
- Construction Management and Site Coordination

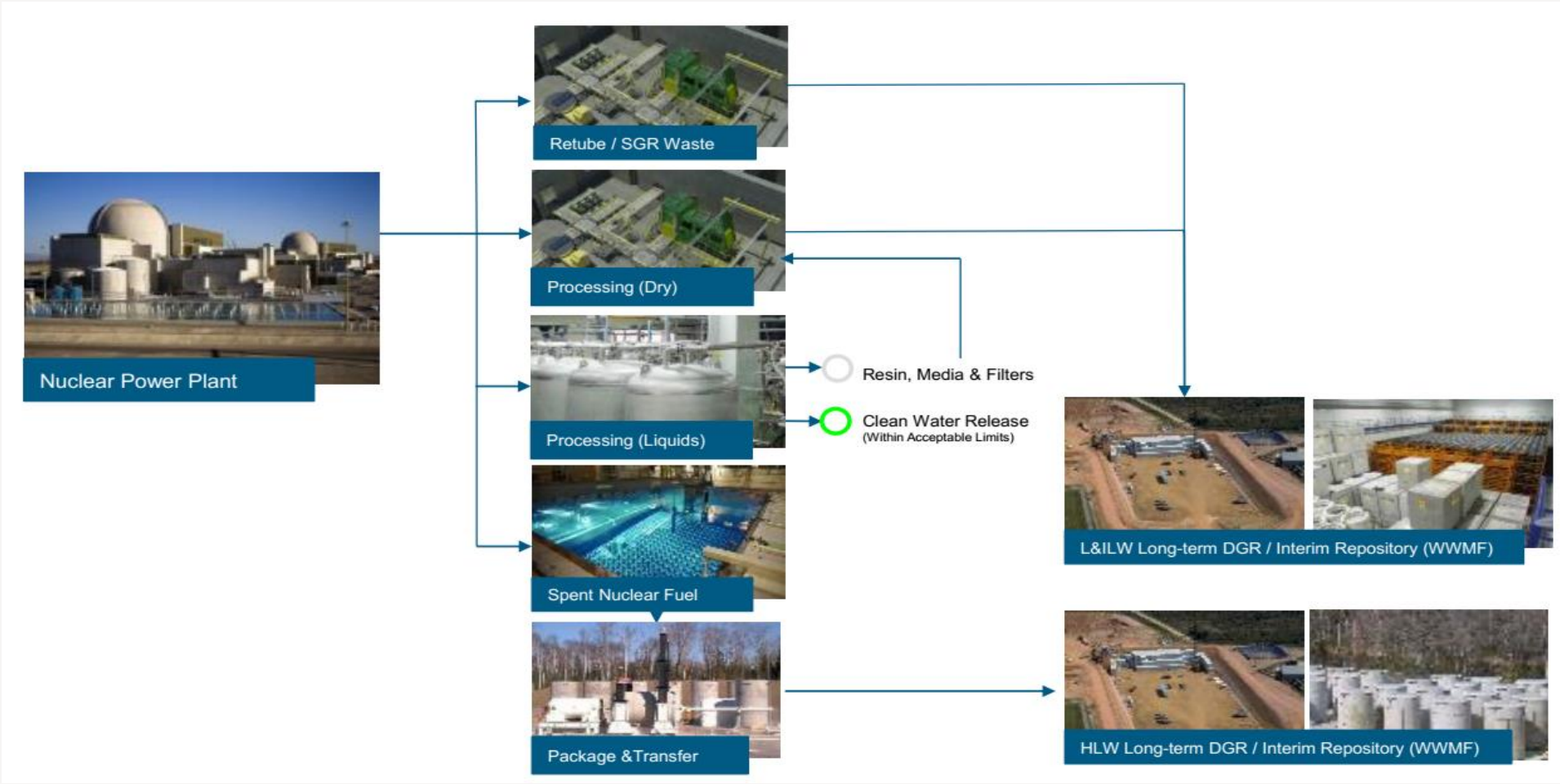
Waste Services

- Facility/Waste characterisation
- Waste Operations

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

SNC Lavalin & ATKINS Waste Management Experience



SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Digital journey
Progress to date

2013
- First £200 scanner purchased with Oculus Rift developer kit

2014
- First deployment at EDF Energy Torness
- First FARO laser scanner purchased

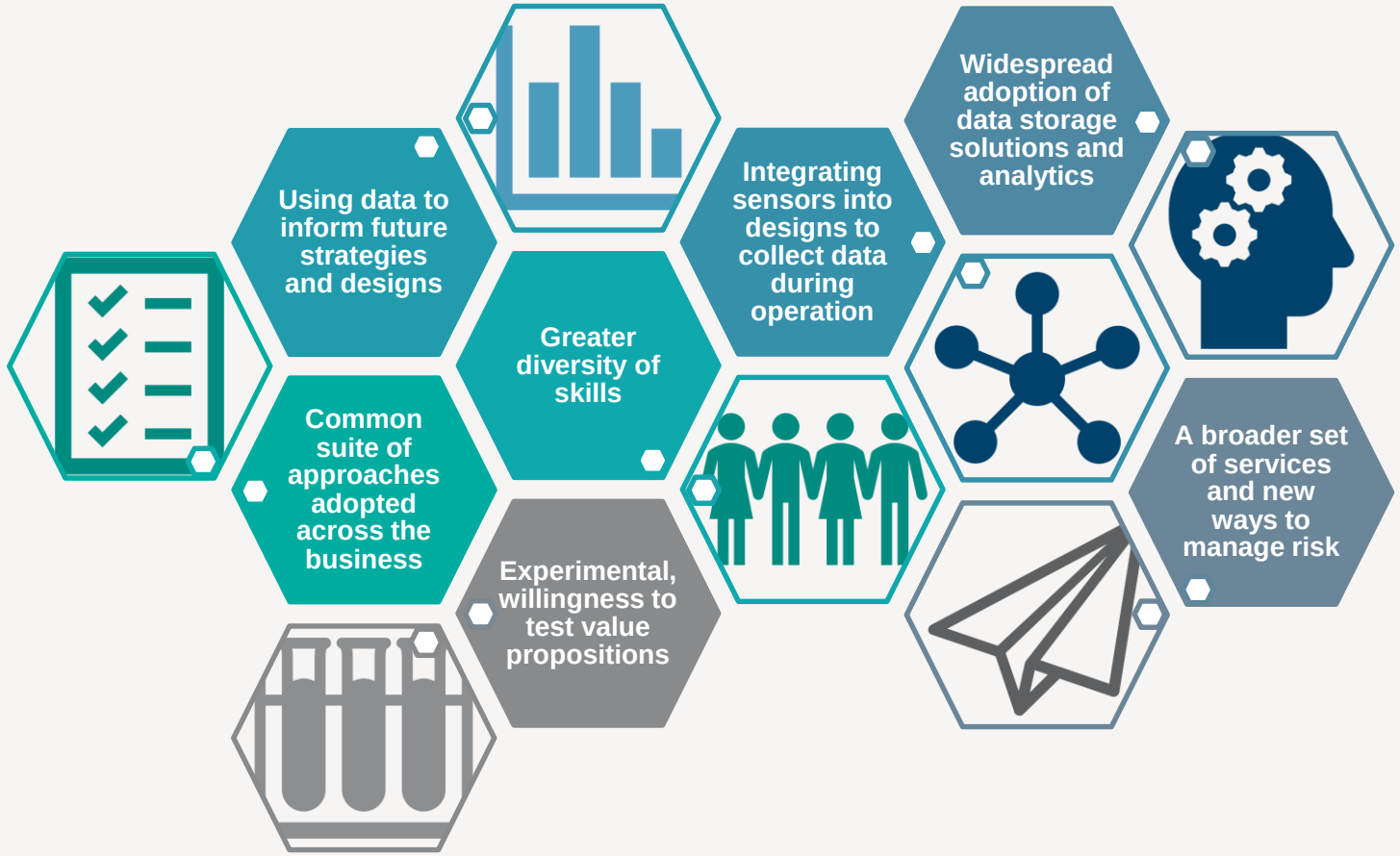
2015
- Investment in sales and business development – Barnwood, Springfields
- Introduced overall digital capability to Sellafield
- DNB outage programme CAE

2016
- PP&T acquisition set technology agenda
- Appointment of 1st Digital Lead in Energy
- Second FARO laser scanner purchased
- ITER scanned

2017
- Major endorsement of our work at DNB
- Approx £1m revenue attributed to Digital
- Integration with SNC-Lavalin
- Added another two FAROs
- SSE Gas Storage framework
- Digital engineering video produced

2018
- 1st Application of Model Based Definition at Sellafield
- 1st drone survey for EDF
- Commitment from CEO level down to Digital
- EDF Supplier of the Year
- Multiplayer VR MVP

How we see this changing our business



Our vision

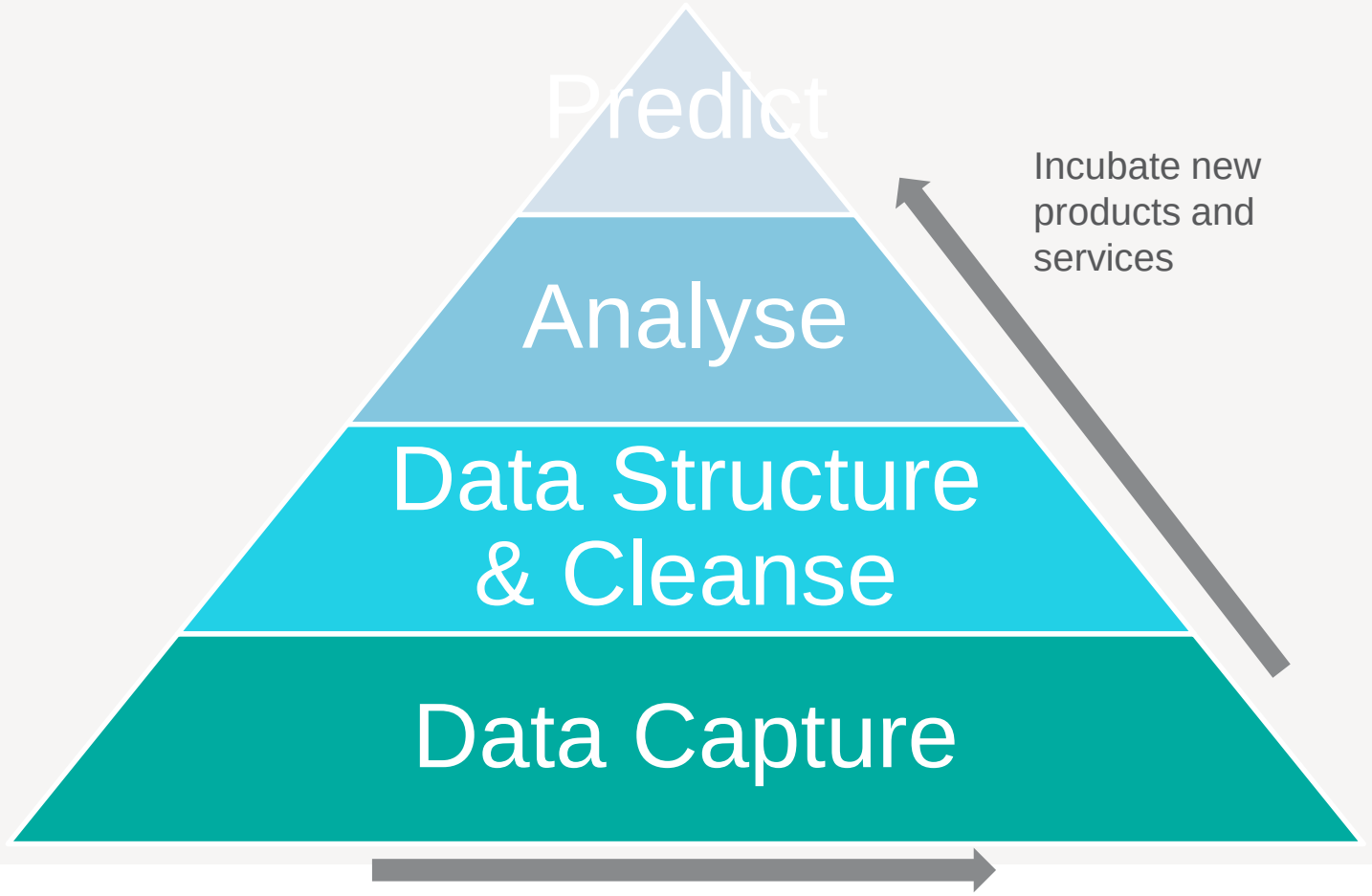
Harnessing data to unlock value for our clients

AI

Machine Learning / Statistics

Automation

Scanning, Sensors, UAVs



Joined forces

On July 3 2017, SNC-Lavalin and Atkins joined forces

- A leading engineering and construction group in the world offering services in oil and gas, mining and metallurgy, infrastructure and power
- Major player in the ownership of infrastructure

- One of the world's most respected design, engineering and project management consultancies serving infrastructure, transportation and energy sectors

Atkins Energy Germany

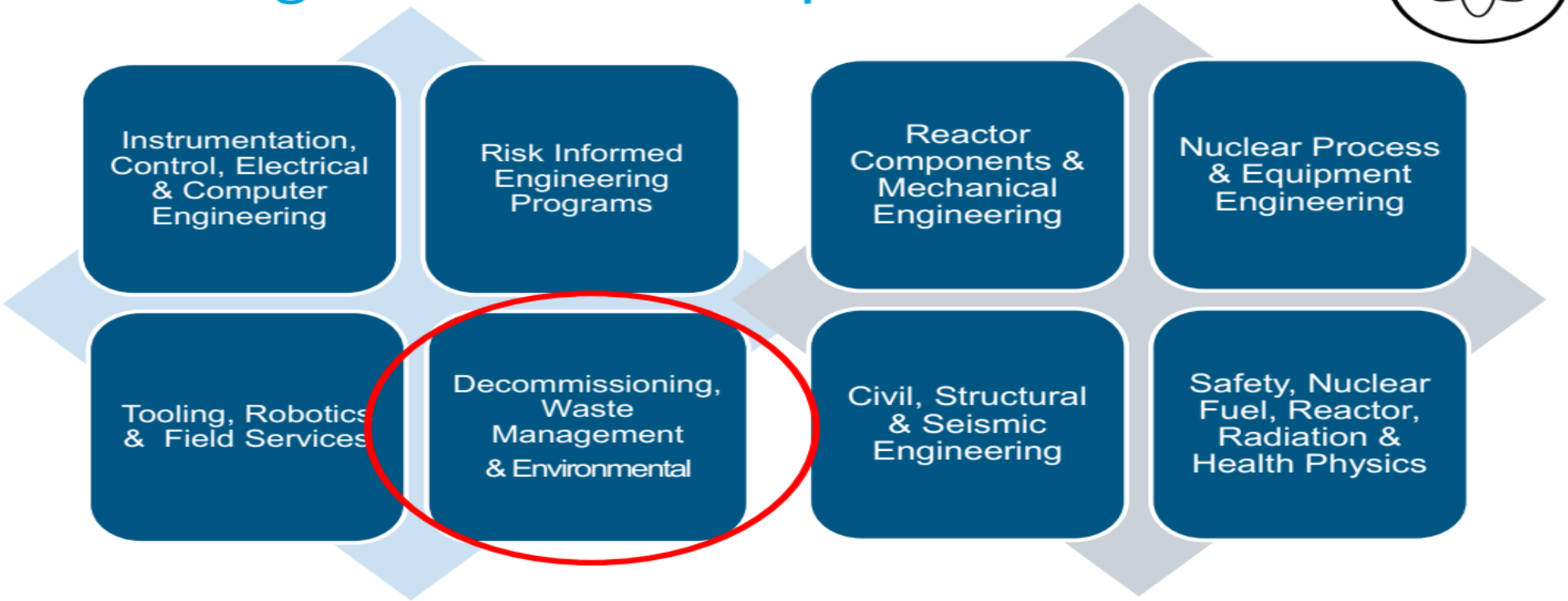
Zentrale SNC Lavalin/ ATKINS, Montreal, Kanada

ATKINS Energy Germany GmbH, Hamburg

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Wide Range of Nuclear Expertise



Services and Technology Offerings across the full Nuclear Cycle

Development → Engineering → Construction → Commissioning → Operation → Decommissioning

SNC·LAVALIN

ATKINS
Member of the SNC-Lavalin Group

Waste Management Options

Considering all available waste routes is the key (on-site/off-site)

Waste routing will drive the approach to segmentation