
Legacy Facilities at Dounreay - Managing Through Life Safety

Tony Wratten
Assurance Unit Manager
Colin McColm
ILW Projects Manager
Dounreay was established in 1955 by the UKAEA to pursue fast reactor technology and its fuel cycle for the civil nuclear power programme.

- 3 reactors were built with a number of associated, laboratory, fuel cycle, administration, waste processing and experimental buildings.

- Due to the experimental nature of the site, there are a number of processes, wastes and liability legacies which are unique to the site.
Fuel Cycle Area Plants

- Constructed in 1950’s
- 2 Reprocessing plants
- PIE Facilities
- Fuel Fabrication Plant
- Uranium Recovery Plant
- Chemical Laboratories
- Raffinate Storage Plant
- Cementation Plant
- Waste Treatment and Storage
- Fuels/Fissile Stores
Design/Safety Case Timeline

1950’s

• Used design codes from that era;
• Radiological protection & criticality effects assessed;
• Material choice, temp, pressure etc considered;
• Large design margins against uncertainty;
• Individual plant modifications assessed;
• Maintenance of as-built drawings patchy;
• Records of incidents/spillages not consistently maintained
Development of Safety Cases at Dounreay

• Late 1980’s, Government decision that from 1990, UKAEA sites would be subject to NII Licensing;

• License requires documented safety cases to be produced, maintained and periodically reviewed;

• 1st generation of safety cases introduced for FCA plants in late 1980’s prior to NII Licensing;

• Produced against tight deadline, quality variable;

• Used probabilistic approach to demonstrate risks were tolerable;

• No engineering substantiation, emphasis was on safety argument rather engineered controls
Introduction of “Modern Standards” Safety Cases

• 1990’s – Increasing NII concerns over material condition of site and level of in-house engineering competence;
• 1998 – NII Direction halted FCA operations;
• New safety cases produced for each FCA plant prior to restart;
• Included retrospective substantiation of design against “modern standards”;
• Reasonably practical improvements identified/implemented to bridge the gap;
• In some cases decision made to close the plant rather than implement improvements (e.g. wet silo, LLW incinerator).
Applying Substantiation to Existing Plant

• Retrospective substantiation is never as effective as design substantiation;
• Deciding what is a “reasonably practicable” improvement is to some extent subjective;
• Makes life difficult for both operators and regulators;
• Need a good screening process to avoid going too far;
• Need to take account of remaining operational lifetime;
• If site funding is fixed, money spent on upgrades will delay decommissioning;
• Post 1998 – hindsight shows that too many systems were upgraded shortly before closure/decommissioning, e.g. replacement wiring, ventilation upgrades made for operational reasons without proper consideration for decommissioning.
Upgrade or Decommission?
Practical Experience

• Building structures – difficult to backfit seismic requirements;
• Cells/caves generally in good condition (but not windows);
• Liquor storage tanks difficult to substantiate, several examples of leakage through gaskets, seals, valves;
• Electrical: HV distribution system increasing problems,
• In-building systems upgraded if long remaining lifetime, new wiring for decommissioning on safety grounds
• Instrumentation – generally upgraded through lifetime as system becomes obsolete;
• Human factors – cumulative effect of extensions made control room panels difficult to understand/operate, new central control room installed;
• Legacy issues – not always predicted by safety case process, make decommissioning difficult (but interesting) – precautionary approach
Zinc Bromide Window – Cracked alpha glass
Zinc Bromide Window – Seepage From Joints
Replacement Leaded Glass Window
Leakage from Flange on UO3 Storage Tank
Corroded Equipment Inside UO3 Glovebox
Typical Early Glovebox Design
Weaknesses Around Gaskets and Joints
Historic Contamination Inside Window
Cable joint failure
Joint failure analysis – ERA Technology

- Failure occurred at crutch area of PILC cable (point of highest electrical stress)
- Failure due to general degradation of PILC cable, accelerated by disturbance during jointing
- General condition of PILC cable poor but similar to other 25 year old cables examined by ERA
- No evidence of any joint construction anomalies contributing to failure mechanism
1 MVA Oil Filled 11 kV – 415V Transformer
Severe Corrosion at Base of Structural Column
Conclusion

• Primary systems have generally stood the test of time well, which is a tribute to the original design engineers;

• Associated infrastructure and systems have suffered more from the effects of ageing;

• “Modern standards” safety cases have provided a systematic methodology for determining need for upgrades;

• Liquors in long-term storage will inevitably come back to “bight you”;

and finally:

• Don’t let the effects of ageing depress you, it does have its’ good points, I won my first golf club monthly medal competition aged 50 so there is hope for us all!!