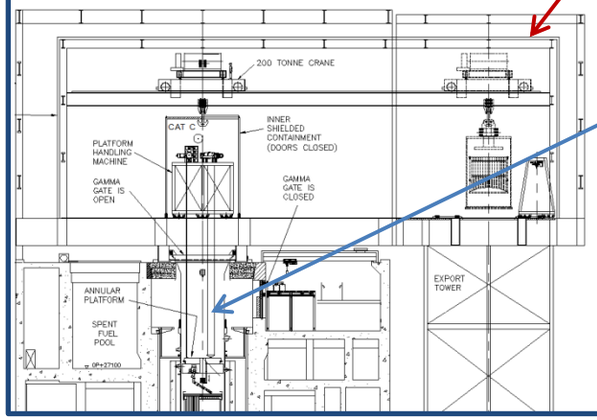
Concept Study of Innovative Approach for Fuel Debris Retrieval
＜Cavendish Nuclear Ltd – Shimizu Corporation – BGE Company Ltd＞

Purpose and Goal

The purpose of this concept study is to identify and describe systems, technology and equipment, and operational procedures that can be deployed to retrieve the fuel debris from the Fukushima Dai-ichi damaged nuclear reactors.

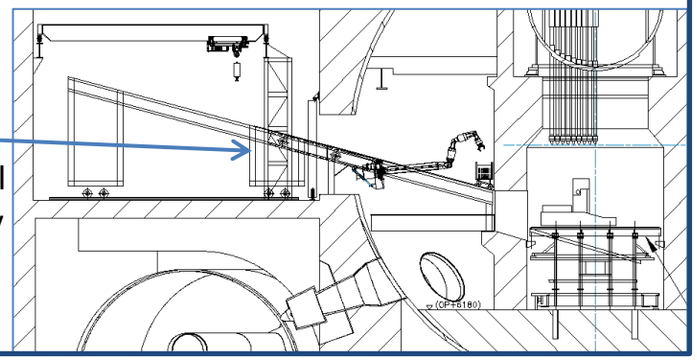
The goal of the project is to demonstrate that it is technically feasible to retrieve fuel debris in a safe and stable manner while operating in an air environment and nominally dry conditions (ie the PCV and the RPV will not be fully flooded).

Overview and Feature



We propose the use of shielded containment structures and a ventilation system to contain radiation and contamination.
A top down system using a suspended work platform is deployed for access into RPV.

A side entry system is deployed for access into pedestal area, and side entry system for access into PCV dry well.



Outcome obtained

Key features of the innovative approach are listed in the table below.

Key learning points:

Importance of having defined containment boundaries with ability to move items between boundaries and continue to maintain containment.
Where detail information on site conditions is incomplete then incorporate operating contingencies into the retrieval system and processes, and validate the requirements when actual survey data is available.

Two work areas are proposed for Fuel Debris Retrieval: Top down system for access into RPV, and side entry system for access into pedestal area and side entry system for access into PCV dry well.	Nuclear ventilation system extracts dust and fume from RPV, PCV and containment housings. Air moves areas of lowest contamination into areas of higher contamination and then passed through two stages of testable HEPA filters.
RPV and PCV are not flooded with water. Shielding and containment functions are provided by engineered structures and systems for dependable safety performance	No increase will be made in the size of opening through the pedestal structure.
Fuel debris retrieval operations are performed in an air atmosphere.	
Defined containment zones and associated (multiple) containment boundaries for the upper retrieval system and also for the lower side entry retrieval system.	
Shielded containment housings and gamma gates are mounted above the operating floor work area (top entry), and outside of the PCV work area (side entry).	
Work Platform system lowered vertically into RPV on suspension cables, and locked laterally against side of RPV.	
Fuel Debris and cut waste transferred out of RPV below shielded roof of DSP.	
Export tower is sized to permit the largest reactor item to be handled in one piece and moved out of the reactor building.	
Waste Handling system for lower side entry system uses same canister handling systems as upper retrieval system.	

Challenges and Issues in the future

Results from inspections and survey of reactor building and reactor internals to inform design of fuel debris retrieval systems.
Selection of specific technologies for cutting and retrieval of the fuel debris.
Definition of the waste management strategy, what is the required form for packaged wastes (reactor internals, etc) and location of the interim waste store.
Definition of the fuel debris processing and storage strategy, what is the required form of the packaged fuel debris, and location of the interim dry store.
Definition of the fuel debris drying and inerting processes that are required to stabilise the retrieved fuel debris in preparation for interim storage conditions.
Creation of break in points, remotely, for the ventilation extraction ducting, and remote connection and sealing of the ducting, and maintaining hydrogen safety.
Creation of break through openings, remotely, in the PCV for deployment of the lower side entry equipment.