Waste Management Processing Projects in the PRC - 16551

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ABSTRACT

Energy*Solutions* continues to provide waste treatment solutions in the Peoples Republic of China (PRC). In 2015 ES had completed installation of systems at two different Nuclear power sites (Haiyang, an AP-1000™ site and Yangjiang, a CPR-1000 site).

This paper discusses progress on these two projects, and provides new information regarding the operation of the systems. The Yangjiang project became operational in the fall of 2015 while the Haiyang project will be done is nearly done with commissioning and is waiting for reactor operations.

Haiyang Project

In the Shandong Province on China's northeast coast, Energy*Solutions*, as part of a consortium with China Power Investment (CPI) and Yuanda Environmental-Protection Engineering Company (a PRC state-owned company), has designed and constructed the site's Site RadWaste Treatment Facility (SRTF). The SRTF provides solid waste processing services for up to 8 AP-1000s™. The SRTF performs the following functions:

1. Five year storage for HICs containing spent resin and filters from the nuclear power plants' waste liquid systems (WLS);

2. Sorting and Compaction System for solid waste generated from Nuclear Power Plant (NPP) operations. This system implements:

    a) Real time radiography to screen 200 liter waste drums for prohibited items,
    b) Pre-compaction,
    c) High Resolution Gamma Spectrophotometry (HRGS) for waste characterization,
    d) Supercompaction,
    e) Solidification of compacted drums inside overpack drums which are filled with 60 MPa compressive strength grout, and
    f) Automatic drum lidding which crimps the drum lid to the drum body.

3. Laundry services for NPP anti-contamination clothing.

4. At the nuclear islands, Energy*Solutions* is providing mobile liquid waste processing systems that utilize Energy*Solutions* Advanced Liquid Processing System ALPS™/Advanced Injection Method System AIM™ processing systems to supplement the NPP's WLS system when radionuclide concentrations exceed release criteria. The spent resins and filters from the nuclear power plants are placed in Energy*Solutions* supplied HICs, dewatered using Energy*Solutions* Self Engaging Dewatering System (SEDS™), and then placed in Energy*Solutions* 8-120B Type B cask for the transport of the HIC between the NPP and the SRTF and, ultimately, to a disposal site once it is ready for operations

Yangjiang Project

Energy*Solutions* is providing liquid waste treatment system (TEU) and solid waste treatment system (TES) for Yangjiang units 3 and 4 for the China Nuclear Power Engineering Company (CNPEC). The Yangjiang site is located approximately 300 kilometers west of Hong Kong. The TEU system processes floor drain, chemical drain, and process drain tanks liquids to achieve a release concentration less than 37 Bq/l. The TES system receives spent resin and filters into HIC containers which are dewatered and subsequently transported to the Yangjiang sites QT building where they are stored for a period of up to 5 years or until a disposal site are available.

- TEU (Liquid waste treatment) consists of the following unit operations:
  - ALPS™/AIM™ system, which includes two separate 8 vessel water treatment systems that consist of granular activated carbon (GAC), cation, anion ion and mixed bed media ion exchange (IX) columns; and
  - A reverse osmosis system for final polishing
- TES (solid waste system)
  - SEDS (Self Engaging Dewatering System)
  - Shielding for the loading and storage of HICs
  - Shielded transport container for the transfer of HIC to the QT building for storage
  - Shielded transfer bell for the transport of spent filters from the NPP operating area to HIC

INTRODUCTION

Energy*Solutions* is providing waste treatment solutions for two reactor sites in the Peoples Republic of China (PRC). Both of these sites (Haiyang, an AP-1000™ site and Yangjiang, a CPR-1000 site) utilize similar systems for waste processing and storage. The current status of these projects is that design, fabrication, and installation has been completed at both of these reactor sites. This paper describes the waste processes, implementation, for these two projects. Commissioning for the Yangjiang project is completed and hot operations have begun, while the

Haiyang project is in the final stages of commissioning and is waiting for reactor completion.

Haiyang Project Overview

Work began on the Haiyang Site Radwaste Treatment Facility (SRTF) in 2010. This facility receives waste from up to 8 AP1000 reactors, volume reduces, stabilizes temporally stores the waste for up to 5 years. Commissioning has been completed on all equipment with the exception of the mobile units at the Nuclear Island, which is still under construction and the SRTF central control system. The SRTF performs the following functions.

1. Receives dry active waste (DAW) from NPP operations for processing. The processing includes removal of prohibited materials, source term measurement, supercompaction, stabilization and 5-year interim storage.
2. Mobile water treatment systems to supplement the NPP WLS in the event that radionuclide concentrations exceed regulatory limits
3. Receipt and storage of spent resin and filters from the NPP WLS system.

DAW Processing System

The SRTF DAW processing system takes a drum containing low-level waste (LLW) processes it through the following operations.

1) Inspection using real time radiography,
2) sorting in a glovebox,
3) pre-compaction of each waste drum,
4) source term measurement using an HRGS,
5) Super-compaction,
6) and overpacking the super-compacted 200 liter drums into overpack drums and encasing them in grout

Mobile Water Treatment System

Energy*Solutions* has provided three mobile water treatment systems containing our proprietary ALPS™/AIM™ systems that are situated in a container that is easily mounted on a trailer for transfer between reactor units. Each system contains:

1) two granulated activated carbon (GAC), and
2) four ion exchange (IX) vessels.
3) internal shielding around the vessels
4) Energy*Solutions* proprietary AIM™ system
5) Receipt tanks and a booster pump.

These mobile treatment units will service all eight reactors at the Haiyang. Additionally, their purpose is to supplement the NPP WLS treatment system in the

event that it is not able to meet the regulatory discharge requirements of 1000 Bq/l. It is expected they will be used after events such as cladding ruptures during plant operations. The following photographs were taken during commissioning at the SRTF. Final commissioning will be completed when the WLS system at the NI is ready for testing.

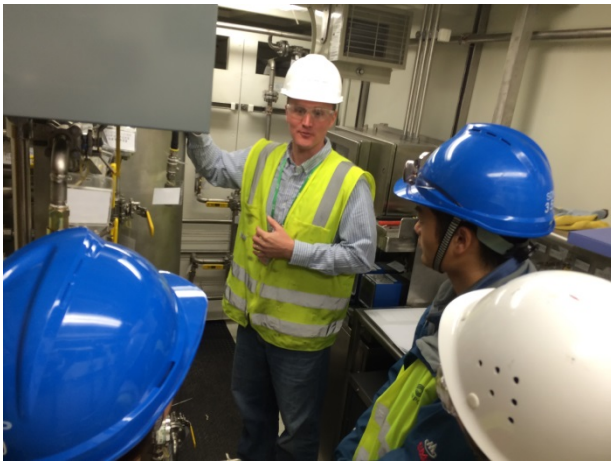

Figure 1: Mobile treatment system during commissioning

Spent Resin and Filter Processing

High Density Polyethylene (HDPE) High integrity Containers (HICs) are being utilized for disposal of the spent resins and filters generated from NPP operations. Once exhausted, the spent resin and filters are loaded into the HICs. Both the filter and resin HICs are dewatered to prepare them for storage/disposal.

After filling and dewater operations are completed, the HICs are transferred to the SRTF from the NPP in an 8-120B cask to interim storage in the SRTF. As with the dry active waste, the HICs will be stored for a period of 5 years. The SRTF has the capacity to store 240 HICs in a 6x20 array stacked two high.

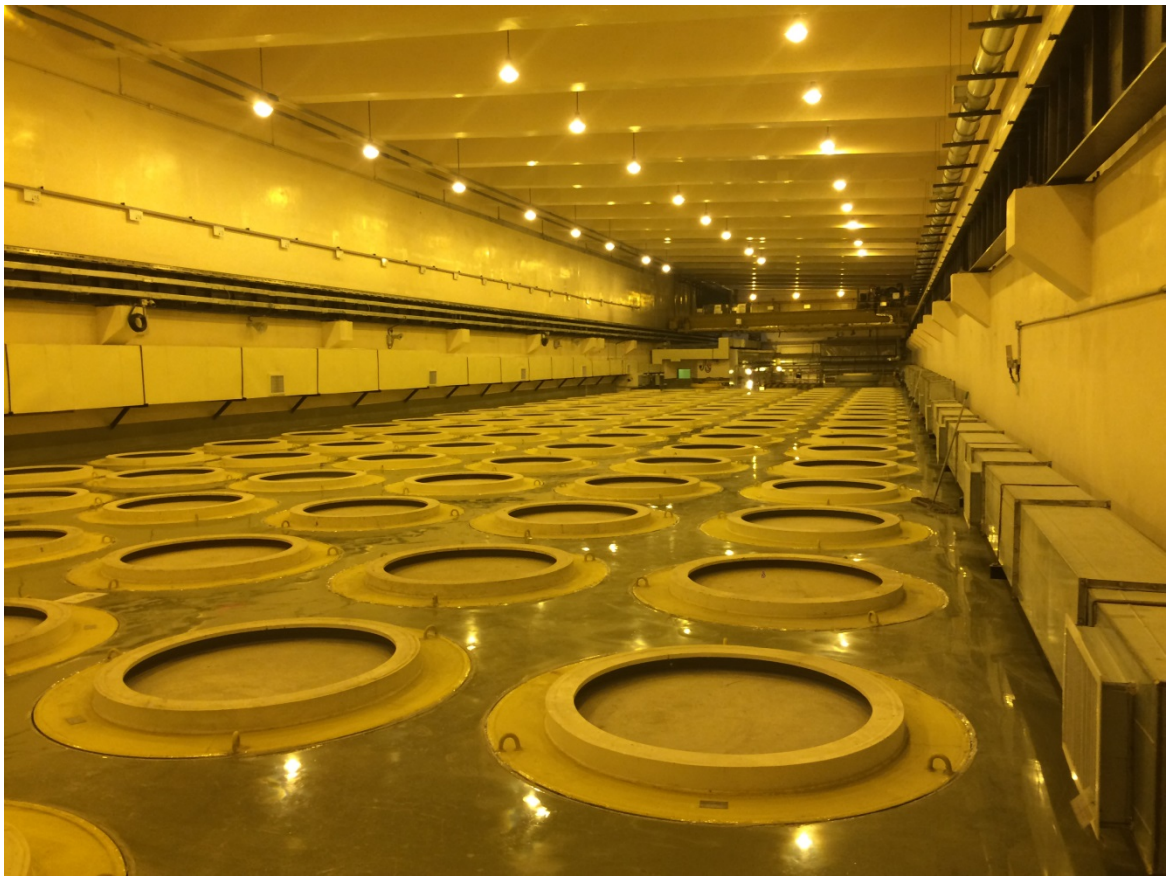

Figure 2: Haiyang SRTF HIC storage area

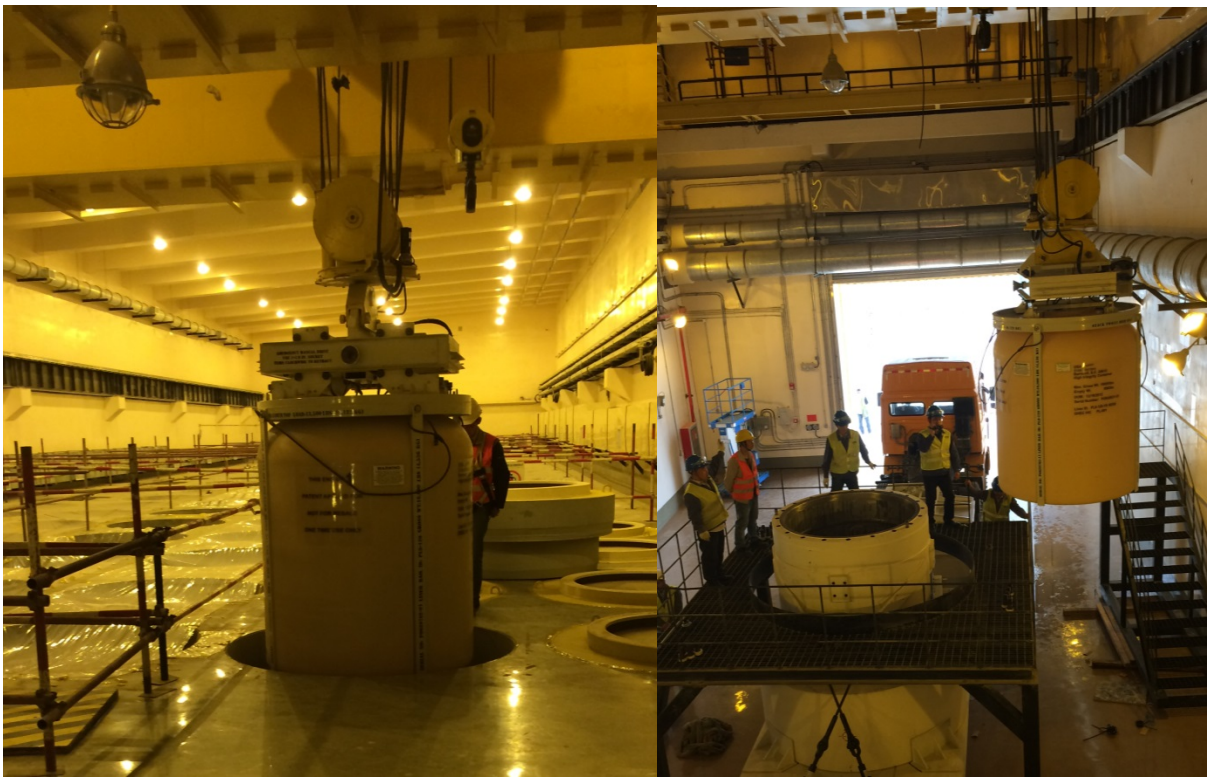

Figure 3: HIC storage area during commissioning

Yangjiang Project Overview

The design of the TEU (liquid waste treatment system) and TES (solid waste treatment system) systems at Yangjiang units 3 and 4 was started in 2010.

TEU system

The TEU system consists of Energy*Solutions* proprietary ALPS™/AIM™ and Thermex™ systems for the processing of liquid waste from the chemical drain, process drain, floor drain, and spare tanks. This system will reduce the radionuclide liquid discharge concentrations to less than 37 Bq/liter. The system consists of two (2) GAC/IX column systems operated in conjunction with a Thermex reverse osmosis system to perform final polishing in order to meet the 37 Bq/liter discharge limit. As part of the equipment, design local shielding and remote control capabilities were provided for the equipment.

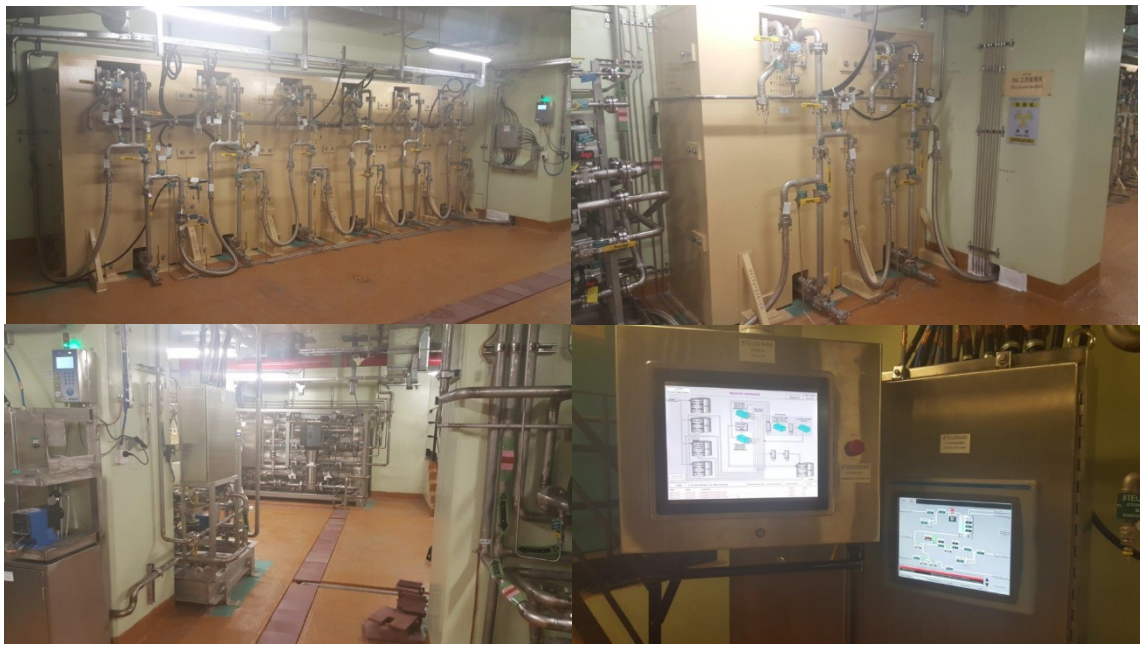

Figure 4: Yangjiang TEU after commissioning

TES system

The TES system provides the equipment that allows for the disposal of spent resin and filters from reactor operations. Once this waste is loaded into HICs it will is transported to the QT building for 5-year storage, a common approach in the PRC.

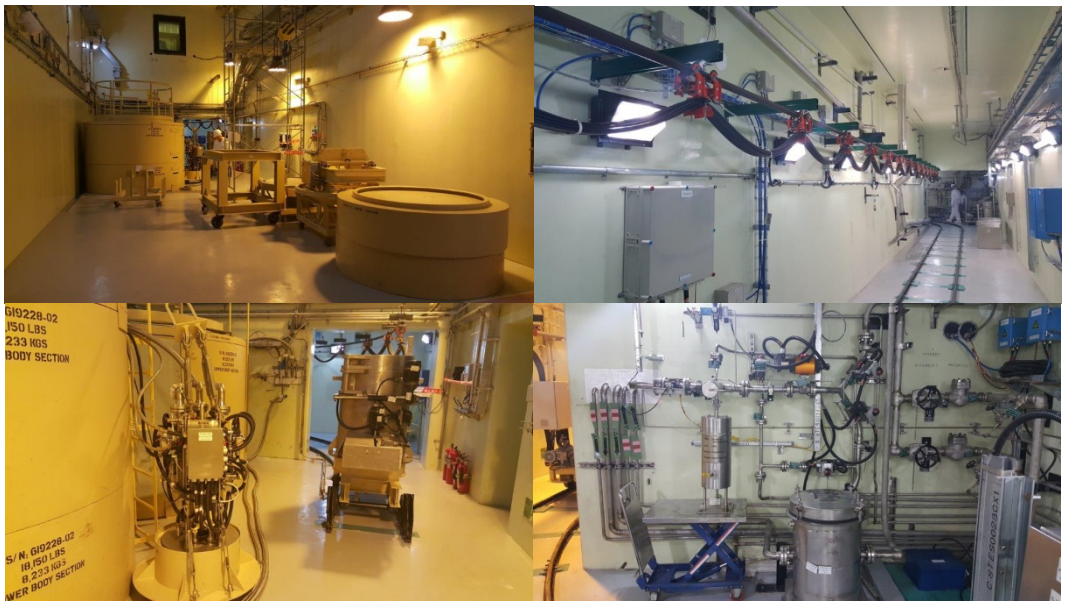

Figure 5: Yangjiang TES final after commissioning

Yangjiang Project Progress

Installation and commissioning for the Yangjiang project have been completed and the reactor has entered into hot operation.

CONCLUSION

As stated above Yangjiang project is completed and has entered into hot operations. Performance testing of the TEU system, to demonstrate that the 37 Bq/l discharge limit is met, should be scheduled sometime during calendar year 2016.

The Haiyang project has completed installation and along with the majority of commissioning. The final system to be commissioned at the SRTF is the central control system. Completion is dependent on several interfaces such as MCC interface issues and repairs to several of the conveyor systems which are being done by the site owner. Additionally, the final testing of the mobile liquid waste treatment systems is waiting for completion of the reactors WLS system.