Development of a Holistic Waste Management Flow Sheet for Nuclear New Build in China- 16634

Edwina Winter and Tim Milner
Energy*Solutions*

ABSTRACT

Nuclear new build is continuing to experience rapid expansion globally with China leading the pace of installed and planned new generating capacity. While new generation LWR's can be largely considered to be standardized the host countries may have legislative and regulatory drivers that can impact their environmental performance and design of waste treatment systems.

Of particular issue is an increasing divergence in the technical approach to liquid waste processing in order to accommodate local environmental impacts and supply chain issues. As a global provider of LWP technology to nuclear new build Energy*Solutions* is seeking to standardize world class environmental performance in liquid and solid waste processing using a standardized suite of technology modules tailored for host country's needs. This approach is consistent with standardization efforts seen historically in the USA and supported by past EPRI programs.

Details are provided of Energy*Solutuions* participation in the provision of world class liquid and solid technology to global nuclear new build. Including details of how innovative technology can be tailored to meet host country needs within the broader concept of standardization for liquid waste processing and management of resultant solid secondary waste.

INTRODUCTION

China is currently at the forefront of the world's Nuclear Energy expansion. A critical aspect of the operation of any nuclear facility is effective management of the waste generated at the facility. China's new Nuclear Power Plant (NPP) build program is ideally placed to plan waste management activities in parallel with the design, construction and operation of the new NPPs.

Energy*Solutions* is a world leading supplier of the full range of nuclear waste management services having operations in North America, Europe and Asia; and are now expanding provision of services in Asia into China to support the new NPP build program specifically in the area of nuclear waste management.

Energy*Solutions* has performed a study of the specific waste management needs at the new China NPP sites and has completed an initial preliminary technical assessment of the requirement to process liquid effluents and disposition associated wastes generated at these new Chins NPP sites. It is understood that the Liquid Waste Processing System (LWPS) for inland NPP's are desired to produce effluents of < 37Bq/l and in some cases < 2 ppm boron. This paper summarizes the technical approach to treat waste arising from the new NPP's in China, the equipment used and the experience of treating similar types of waste in the US.

The Yangjiang 3 and 4 CPR 1000 PWR's located in Guangdong Province China that recently came on-line employ the technology and methodology described in this paper and similarly the waste management systems and processes for the Haiyang AP1000's in Shandong Province are supplied by Energy*Solutions*. Moving forward and building on this success Energy*Solutions* is now is now engaged in deployment of advanced volume reduction technology such a steam reforming of spent ion exchange resin and Dry Active Waste (DAW).

EnergySolutions is working closely with suppliers and customers in China to develop a holistic approach to waste management serving the rapidly expanding NPP new build program . This approach seeks to deploy uniform technology modules producing a minimal volume of secondary waste in disposal compliant forms. The technology modules are deployed in arrays as required to suit the NPP's waste management objectives inclusive of minimal solid secondary waste generation and zero active liquid discharge where desired.

1.1 TECHNICAL APPROACH

In the USA, Energy*Solutions* operates in 40 states at most of the 104 of the USA's operating power reactors. Our patented liquid waste processing systems have processed more than 4M m³ of radioactively contaminated water from US NPP's and we continuously update and improve our systems as technology develops. We currently have more than 30 systems in operations at US power reactor sites and we routinely treat over 70 million gallons of contaminated water every year at reactor sites in the USA. Energy*Solutions* routinely provides systems and combinations of systems to power utility companies that operate both PWR and BWR reactors to treat radioactive liquid and solid wastes and disposition wet solids much the same as those anticipated for the China NPPs.

Energy*Solutions'* Liquid Waste Processing (LWP) system designs are based upon the continuous re-engineering efforts utilizing lessons learned from processing millions of gallons of liquid waste per year and over one billion gallons of Nuclear Power Plant (NPP) radioactive liquid waste processed in the US.

The solid and liquid waste processing equipment and systems are designed to safely and cost effectively disposition radioactive wastes generated by new build nuclear power plants. Treatment is performed with a mix of fixed, modular and mobile processing systems. Resins and spent filter cartridges are remotely packaged directly into High Integrity Containers (HICs), an approach that provides major benefits from an ALARA, waste minimization, and capital and operating cost perspective. Remote operation of the waste processing equipment in the Site Radioactive Waste Treatment Facility (SRTF) provides similar benefits.

All processes are well proven technology systems and equipment currently in use at nuclear power plants in the USA or elsewhere. It is understood that, as China moves forward with its major new build program, the time is right to develop a holistic approach to liquid waste processing and other waste management activities. This approach will seek to establish common designs generating uniform secondary wastes to simplify waste management activities and achieve new standards in decontamination and secondary waste volume reduction.

Process and module design is a critical activity and the designs must have features to minimize the possibility of non-random, concurrent failures of process and systems, which include:

- Protection systems and instrumentation and control systems designed to fail into safe condition if events such as disconnection, loss of energy or motive power or adverse environments are experienced, and radiation interlock monitor systems will fail safe on loss of power or essential services.
- Protection systems are designed to permit safe periodic testing of their functions while the plant is in operation to confirm ability to perform their intended safety functions. The design of each interlock enables testing of the interlock without challenging its safety function.
- When developing and justifying equipment design and physical controls, methods are used to assure that occupational exposures are kept ALARA.
- The design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupancy is to maintain exposure rates below limits defined in the appropriate Chinese standard and as far below this average as is reasonably achievable.
- The design or modification of a facility and the selection of materials includes features, which facilitate commissioning, operations, maintenance, decontamination and decommissioning. This requires that a detailed systemization philosophy is developed early in the design process including modularization of systems such that maximum benefit can be gained from pre-delivery testing. This approach also allows commissioning by system to enable earliest effective operations of a fully integrated facility.
- The new build waste management systems are designed with the objective of providing multiple layers of protection to prevent or mitigate the unintended release of radioactive materials to the environment. Selection of defense-in-depth features considers:
  - Minimization of material at risk,
  - The use of conservative design margins,
  - Quality Assurance,
  - Physical barriers for protection against the release of radioactivity or personnel exposure to elevated radiation levels,
  - The means to detect accidental releases requiring emergency responses,
  - The provision of emergency plans for minimizing the effects of an accident.

- The new build waste processing systems are designed to provide adequate protection of the health and safety of public and workers, including those at adjacent facilities, from the effects of potential facility accidents involving the release of, or exposure to radioactive materials.
- The process systems are designed to minimize the production of wastes and minimize the mixing of radioactive and non-radioactive wastes.

2. LIQUID WASTE PROCESSING DESCRIPTION

Each NPP can be provided with a full or partial liquid waste processing system, comprising ALP™/AIM™, Thermex™ and Concentrate Dryer (CD Dryer) (referred to as LWPS), installed in a modular configuration. All the equipment required to process waste liquids, including normal waste streams, chemical waste streams, ground water intrusion, floor drain and process drains can be included. Off-normal waste water from failed fuel cladding or steam generator tube rupture (SGTR) is processed by a mobile skid-based system housed in a Sealand™ container prior to final processing by the modular equipment. This method is used to minimize the source term and the dose associated with it in the process area.

At present, the ALPS™ is operated at 17 customer sites in the US. Because each site offers unique challenges, the ALPS™ system is designed to meet specific goals and produce effluent water that meets all customer quality and environmental guidelines. The AIM™ system is one example of how Energy*Solutions* developed technology to remove problematic constituents (e.g., Ag 110m) and increase system efficiency. The Energy*Solutions'* ALPS™/AIM™ system is engineered and designed to meet all of the following basic customer's goals:

- Perform work safely.
- Generate the smallest amount of waste possible.
- Achieve the lowest environmental release possible.
- Adhere to ALARA guidelines.
- Operate cost-effectively.
- Achieve discharge target of 37 Bq/L based on supplied source term data.

Some of the basic ALPS™ components include:

- Reusable pressure vessels that can be utilized for ion exchange or deep bed filtration.
- A control skid or valve manifold with optional booster pump.
- A chemical addition system, such as AIM™.
- Vessel shielding.
- Cartridge or bag filter(s).
- Sample sink for remote sampling.

Typically, ALPS™ sites are maintained by one Energy*Solutions* Technical Service Representative. The Technical Service Representative maintains and operates the system on a daily basis. Furthermore, the Technical Service Representative's extensive knowledge allows him to troubleshoot the equipment and minimize downtime. Additional Technical Service Representatives are assigned as needed to support outage related activities and special process evolutions where a second shift is needed. Treatment of liquid waste is performed by pumping waste water from the plant holdup tanks to the first piece of equipment, the control skid in the ALPS™ system. This skid acts as the interface between the plant and the processing equipment. Waste water then enters the first vessel containing granular activated carbon (GAC) for rough filtration of particulates and organics such as oils, grease and other constituents that may foul downstream process media. Waste water leaving this vessel is injected with a chemical additive from the AIM™ chemical injection system to coagulate corrosion products and colloids that are too small for standard filtration. An in-line monitor downstream constantly samples the waste stream and, through a feedback loop, adjusts the injection rate to maintain a precise charge. The treated waste stream enters the second GAC vessel where final particulate and colloid removal takes place. The waste stream is now relatively particulate free including colloids and corrosion products such as Co-58, Co-60, Ag-110, Mn-54, Cr-51, etc.

Four more process vessels just downstream of the GAC vessels, with the same media capacity, can be loaded with a wide variety of ion exchange media for the removal of soluble ionic species remaining in the waste stream. The ion exchange vessels remove nearly all of the remaining activity in the water. At this point, the ALPS™/AIM™ portion of the process is complete. The waste stream has been clarified and nearly all particulate, colloidal and ionic species removed.

The low release limits for inland NPPs require further processing for removal of boron, TOC heavy metals, other environmental pollutants and any remnants of activity prior to effluent discharge to aquatic environments. The ion exchange process can be used to remove boron but using ion exchange media, anion resin, would generate large amounts of waste ion exchange media.

In order to maintain secondary waste volumes as low as practicable, ALPS**™** effluent from the ALPS™ system is processed by Thermex™ Reverse Osmosis (RO).

Energy*Solutions* operates Thermex™ systems at four Boiling Water Reactor (BWRs) and one Pressurized Water Reactor (PWR) in the USA. The Thermex™ system is offered to as a polishing step to the ALPS™/AIM™. This ensures consistent discharge targets will be met including removal of species such as Sb-125, Ag-110m and Co-58. These are known to challenge most liquid radioactive treatment processes and are specifically targeted by the Energy*Solutions* ALPS™/AIM™ and Thermex™ systems.

The Thermex™ systems typically process approximately 190,000m³ of effluent annually. All Thermex™ systems consist of the same primary components.

The Thermex™ system has the ability to process a very large amount of wastewater, drastically minimizing the production of solid waste, while creating water that can be returned to the plant for further use, should environmental discharge of this relatively valuable commodity not be desired.

The four basic customer goals for Thermex™ are as follows:

1. Provide effluent water quality suitable for discharge to the environment at 37 Bq/L or lower. As an option, it can also eliminate the need for discharge by facilitating reuse.
1. Generate the smallest amount of secondary waste possible.
2. Adhere to ALARA guidelines.
3. Perform work safely.

Since the inception of the Thermex™ system, over 1.3 million m³ of water have been processed. Energy*Solutions* first began operating the Thermex™ system with just a single-pass Reverse Osmosis at Plant 1 in February 1995. In June 1997, a Thermex™ with both a first and second pass Reverse Osmosis entered into service. Since that time, over 379,000m³ gallons of water have been processed through that system, and Energy*Solutions* systems have processed over 3,800,000m³ of liquid waste.

Processing through Thermex™ is achieved by directing ALPS™/AIM™ effluent to a Process Feed Tank (PFT). This is used as the feed supply tank for the Thermex™ Reverse Osmosis (RO) process equipment. Once an adequate volume of process water is in the PFT, the booster pump is engaged to supply the RO with flow. A process feed filter is in-line between the PFT and RO to protect the membranes from any stray particulate that could foul the membranes. Chemical addition is performed to improve the removal of boron. Boron chemical speciation in PWR effluent streams is complex and can be any of the listed below.

PWR Effluent Stream
$H^+ + B(OH)^-_4 \Leftrightarrow H_3BO_3 + H_2O$
$2B(OH)^-_4 + H^+ \Leftrightarrow B_2O_3(OH)^-_3 + 2H_2O$
$3B(OH)^-_4\ 2H^+ \Leftrightarrow B_3O_3(OH)^-_4 + 5H_2O$
$4B(OH)^-_4\ 2H^+ \Leftrightarrow B_4O_5(OH)^{2-}_2 + 7H_2O$
$K^+\ B(OH)^-_4 \Leftrightarrow KB(OH)_4$
$Ca^{2+} + B(OH)^-_4 \Leftrightarrow CaB(OH)^-_4$

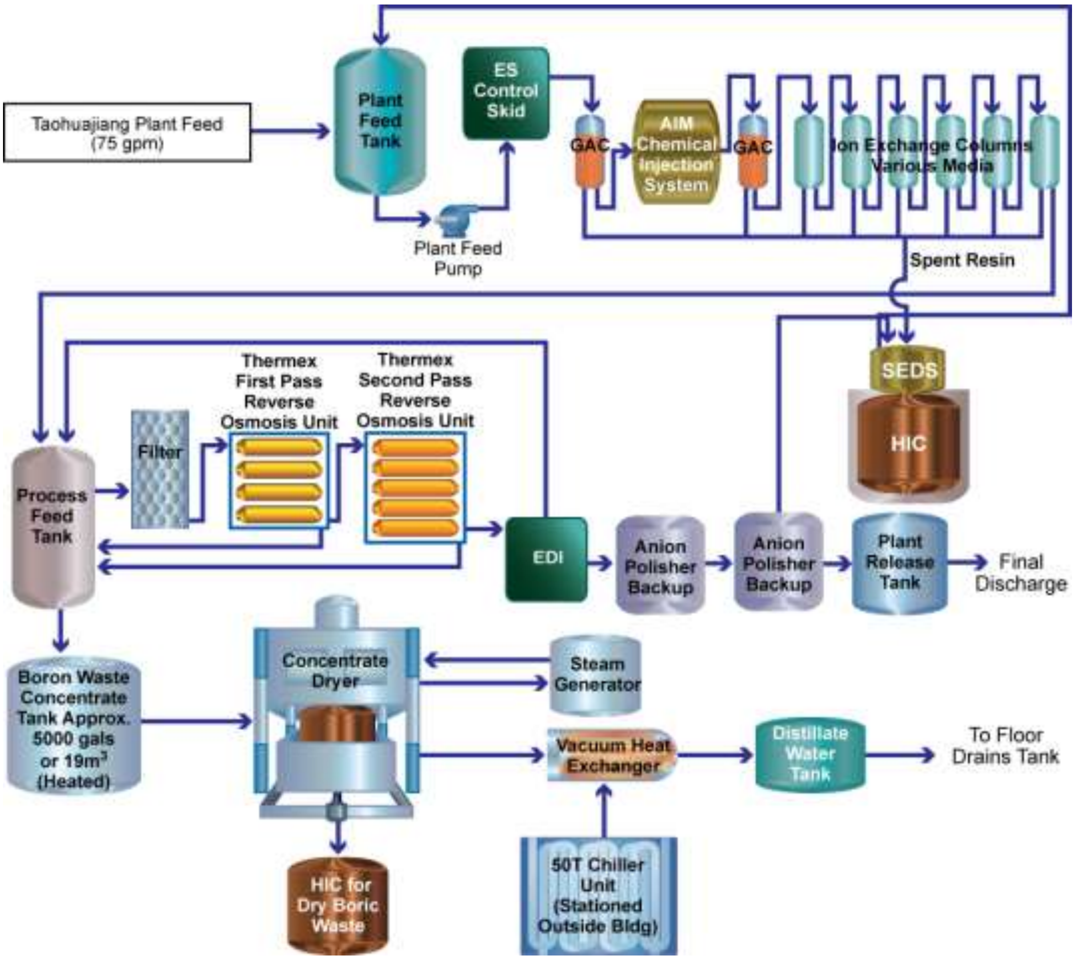

Figure 1 – Boron speciation and Schematic of a typical Liquid Waste Processing System (LWPS)

In addition to pH adjustment, it is important to monitor and control parameters that contribute to concentration polarization in RO membranes. Concentration polarization results in regional high salt concentration at the membrane boundary as water exits the system, and this leads to scaling and salt leakage. These negative consequences are minimized in the Thermex**™** system by careful process control, on-line monitoring of critical species and appropriate media selection upstream to remove troublesome ions from the RO influent.

Permeate from the RO is directed to a second final polishing ALPS™ system to remove trace species. The effluent is then monitored and upon confirmatory analysis is released for discharge.

Concentrate from the membranes that is returned to the PFT will increase the concentration of any chemical constituents in the process stream. Concentration limits are established for maximum allowable feed concentration to the membranes. These will include silica and boron as restrictive factors to assure the membranes are not "scaled" or damaged. When these limiting factors are reached, the PFT contents are discharged to the heated Concentrate Storage Tank (CST). Once the PFT has been emptied the processing of the waste stream can resume. The tank level can be drawn down to the CST without stopping the process.

The Concentrate Storage Tank (CST) is used to holdup the concentrated reject, or brine, from the RO membranes and PFT until an adequate volume is available for the CD-1000 dryer processing..

The CD-1000 dryer receives waste water or concentrate from the CST. The concentrate is fed into the drying chamber at a controlled rate to match the process performance. The vapor phase from drying is run through the chiller unit to condense the vapor back to liquid and direct it back to the floor drain system. The remaining concentrate continues to dry as the rotating blades move it through the chamber until a dry product is produced and dropped out through the waste valve into a waste disposal container. The container, stationed just below the dryer, can be a 200L drum or HIC container.

The other secondary waste stream from the liquid waste processing system is spent ion exchange media. This is discharged from the ion exchange vessels through the spent media line on the bottom of each vessel. A line is connected to either the Energy*Solutions* SEDS dewatering system or can be directed to the plant spent resin storage tanks. Service air and service water are used to fluidize the media and "slurry" it to either end point. The vessel can be completely evacuated in just 10 to 15 minutes, ready for new media. The new media is pumped directly into the top of the vessel through the new media fill line. An AOD (Air Operated Diaphragm) pump is used to pump the media into the vessel.

The typical liquid waste processing system can be operated in a manner such that it processes in a batch method for relatively small volumes of radioactive waste water. However, this system is capable of processing over 11,365m^3 (2,500,000 gal) of waste water per year based on 8 hours per day, five days per week of operation should the NPP require additional processing capabilities.

While the installed LWPS in each NPP can handle most waste water types, there are advantages to using the mobile Sealand™ housed process equipment. It is highly mobile with shielding incorporated into the skid design, which reduces setup time. The system can be setup near the source of the waste water to be processed for those few occasions when pumping the waste water through plant piping to the waste holdup tanks may not be possible or desirable. The smaller size process vessels reduce dose source term for failed cladding waste water processing, reducing the amount of shielding required.

It is important to recognize that the efficacy of the Energy*Solutions* system is not the cumulative impact of individual water treatment modules to achieve an effluent discharge target. It is a synergistic communication and optimization of these modules to achieve an overall processing methodology and level of performance that far exceeds the cumulative summed capability of the individual process steps

The Energy*Solutions* mobile system houses processing equipment to treat the off-normal liquid effluents generated from the new build NPP's and is engineered and designed to meet all of the following basic customer's goals:

1. Perform work safely. (Numbering needs fixing here)
2. Generate the smallest amount of waste possible.
3. Achieve the lowest environmental release possible.
4. Adhere to ALARA guidelines.
5. Operate cost effectively.
6. Achieve discharge target consistent with local client requirements.

Off-normal liquid waste is treated using the mobile equipment based on activity in the waste stream. If the activity would cause an unacceptable dose environment for work with the LWPS, the mobile system would be used to pre-process the high activity waste water as a pretreatment for the LWPS. The mobile system uses the same principles for processing as the ALPS™ /AIM™ systems.

In the mobile Failed Fuel Primary Loop Liquid System, the Failed Fuel Primary Loop Liquid is pumped from the Effluent Receipt Vessel through the first GAC column where the majority of any entrained solid or particulate will be removed. The process stream leaving the first GAC column is dosed with polyelectrolyte to coagulate any colloids prior to entering the second GAC column. The second GAC column will remove any fine particulate and the coagulated colloidal material.

The solid free liquid stream contains soluble contaminants, both cationic and anionic, that are removed in the ALPS™ ion exchange array. The treated liquid product is pumped to the LWPS via plant installed monitor tanks or from the effluent receipt vessel of the mobile system.

The LWPS will also be used to process effluent arising in the case of a Steam Generator Tube Rupture (SGTR) and will treat the liquor generated from dewatering the High Integrity Containers (HICs) loaded with spent resin from the NPP and spent wet liquid filtration cartridges. It will also be used to treat small amounts of contaminants washings or groundwater drains if either cladding breach or SGTR occurrences make this necessary.

The highly mobile system can be prepared for processing most any type of waste water by first analyzing the waste stream, selecting the proper media for processing and loading the process vessels accordingly.

Figure 2 — Typical EnergySolutions'mobile demineralization system.

the

Figure 3— Views on control panel using installed fillhead camera.

Periodically, GAC columns and the ion exchange columns in the ALPS™ and AIM™ systems must be flushed to remove spent GAC and loaded ion exchange media. This is performed using flush water. Fresh GAC and ion exchange media will be added to the respective column

3. SOLID WASTE PROCESSING AND HANDLING OF SPENT ION EXCHANGE RESINS MAETP PROCESS DESCRIPTIONS

Energy*Solutions* has provided radioactive waste dewatering equipment and services for nuclear facilities since 1974. The Self-Engaging Dewatering System (SEDS) is Energy*Solutions'* newest design to provide a safe and efficient method of transferring and dewatering ion exchange resins and filter pre-coats.

The equipment is used in concert with the Energy*Solutions'* US fleet of High Integrity Containers (HICs) shielded casks and transport infrastructure for the safe conditioning, packaging, transport and disposal of radioactive wastes. Dewatering using SEDS reduces the water content to below 1%.

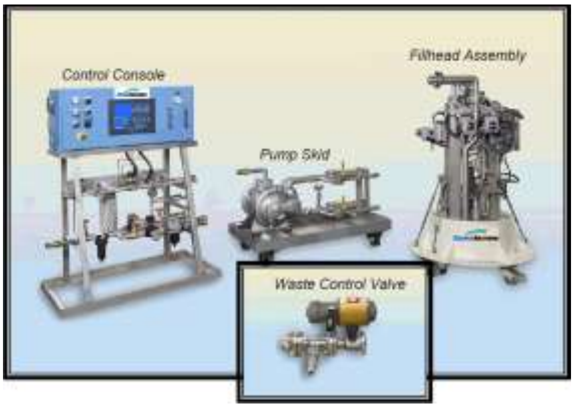

Figure 4 — SEDS Components.

The SEDS is designed to remove slurry water from the HICs. The slurry water acts as a transportation medium when transferring both resin and GAC media into the HIC. Removal of the slurry water from the resin and filtration media in containers reduces the volume of waste as well as ensuring that transportation and disposal site criteria are achieved. Major components of the SEDS include a dewatering pump skid, fillhead assembly, control console, waste control valve (Figure 1-9) and the HIC.

The control console allows the operator to remotely control or monitor the fillhead engagement/removal, valve positions, level detection system and temperature indication. The control console has touch screen controls and indicators. It also has a high-resolution monitor for the remote viewing camera located on the fillhead assembly.

3.1 High Integrity Containers - HIC

Energy*Solutions* uses High Integrity Containers (HIC's) for spent filter media, resins, dried concentrated boric waste and spent filter cartridges generated by the NPPs. In the United States, HICs are used for radioactive waste disposal of spent resins, spent filters and filtration media. HICs have been licensed for use in shallow land disposal by the Department of Health and Environmental Control of the State of South Carolina for over 25 years. HICs are also disposed at every active US LLW disposal site. HICs range in size from 0.23m³ to 8.5m³, with many combinations in size, internal configuration, and lifting apparatus. Container type and size selection are dictated by several criteria:

- Classification of the waste,
- Dose rate of the container controlled to match the available shielded transport package,
- Transportation regulations and burial site acceptance criteria.

HICs are made from cross-linked polyethylene, which prevent corrosion and extend the security of the container in shallow land burial or storage conditions for a longer period of time than can be achieved with steel drums.

Access to the inside of HICs and HIC internals is through a deep threaded lid inserted into the top of the HIC. HICs can be used for dry activated waste, cement encapsulation of radioactive components, dewatering of spent resins, carbon, pre-coat sludge such as ion exchange powdered medias and high or low-level mechanical filter cartridges etc.

For dewatering operations with spent media, the proper internals must be selected and installed. The filter arrangement inside the container allows the water used to transfer the media to the liner to be pumped out while all of the solids or media remain in the liner

US PWRs primarily use bead type ion exchange media for both in-plant ion exchange vessels and wastewater processing systems. Additional options for these containers, allow them to be stacked depending on the type and model liner.

3.2 Major Advantages of HICs over Steel Drums

- Can store approximately 50% more waste in the same floor space as 200L drums stacked two high. Ultimately reducing the size and cost of a storage facility.
- The space savings for storage is correlated to the final disposal facility. The disposal facility can now handle 50% more waste in the same space.
- The HIC can be loaded remotely with the SEDS transfer and dewatering system. Preparing the HIC for transfer, complete the loading, dewatering the container to less than 1% water by volume, removing the fillhead from the liner, and capping the liner would result in zero exposure to the operator.
- The fillhead is sealed to the liner when installed. This reduces the potential to contaminate the surrounding process area. Liners would not be subject to breaching that frequently happens in drum compaction.
- Because of the lower potential of contaminating the process area, maintenance on the equipment would require little to no operator dose. Also the fillhead can easily be moved to a remote location for servicing with or without disconnecting the hoses and cables. There are very few moving parts, hence there is very little regular maintenance required.
- A HIC will not corrode or leach the contents to the environment.
- HICs, like drums, can be capped remotely and, with the use of the Energy*Solutions'* HIC Grapple Device, can be moved from the process area

to storage and from storage to transport vehicle.

3.3 HICs and Transport Casks Analysis

The HICs and transport casks are based on a series of shielding analyses that have been performed to determine the dose rates expected handling waste from new build NPP's.

The PL8-120 HICs is used for all resins and spent filters cartridges. This enables the use of standard HIC grapples and transport casks, and also standardizes spare parts. The PL8-120 casks are approved for Type B materials and are suitable for both on-site and off-site transportation the disposal site.

Figure 5 — EnergySolutions' standard PL8-120 HICs and Casks are used to disposition spent media and filter cartridges.

4. SOLID WASTE HANDLING AND PROCESSING – SITE RADWASTE TREATMENT FACILTY (SRTF)

The AP1000 manages solid waste in the SRTF. All processes utilized for the SRTF are well proven technology systems and equipment that are currently in use at nuclear power plants in the U.S. or elsewhere.

The technology involved in achieving the SRTF functional requirements is primarily based upon an EnergySolutions established pedigree of plant and equipment;

Figure. 6 - Haiyang

applied in a manner that suits the SRTF process and waste streams. This technology includes pre-compaction and a 2000-ton force supercompactor, interconnections and automated material handling. The characterization equipment includes real-time radiography (RTR) units and HRGS drum assay measurement systems. Additionally, skid based liquid effluent processing and wet solid secondary waste handling technology modules and processes are employed to prepare secondary waste for interim storage / final disposal.

The SRTF project adopted a particularly stringent and intensive pre-installation testing philosophy to ensure that equipment would work safely and reliably at the required throughput. This testing included the complete off site integration of functional components with the attendant integrated control system and undertaking continuous, non-stop, operational effectiveness proof tests.

The technology deployed at the SRTF is primarily based upon an Energy*Solutions* established pedigree of plant and equipment; applied in a manner that was directly applicable to the process and waste streams.

The philosophy of technology selection employed by the Energy*Solutions* is to select, processes and equipment that have an established track record. This results in minimization of uncertainties and any development work to resolve uncertainties is targeted at demonstration and increasing confidence rather than the more risk involved process of invention.

The past project experience that was drawn upon to meet the SRTF functional requirements can be summarized under the following technology modules. Characterization of the waste streams is conducted by radiography, radioassay or chemically, as appropriate. The radiography and radioassay detection principles chosen were well established, but technology and system advancements were applied to improve detection limits.

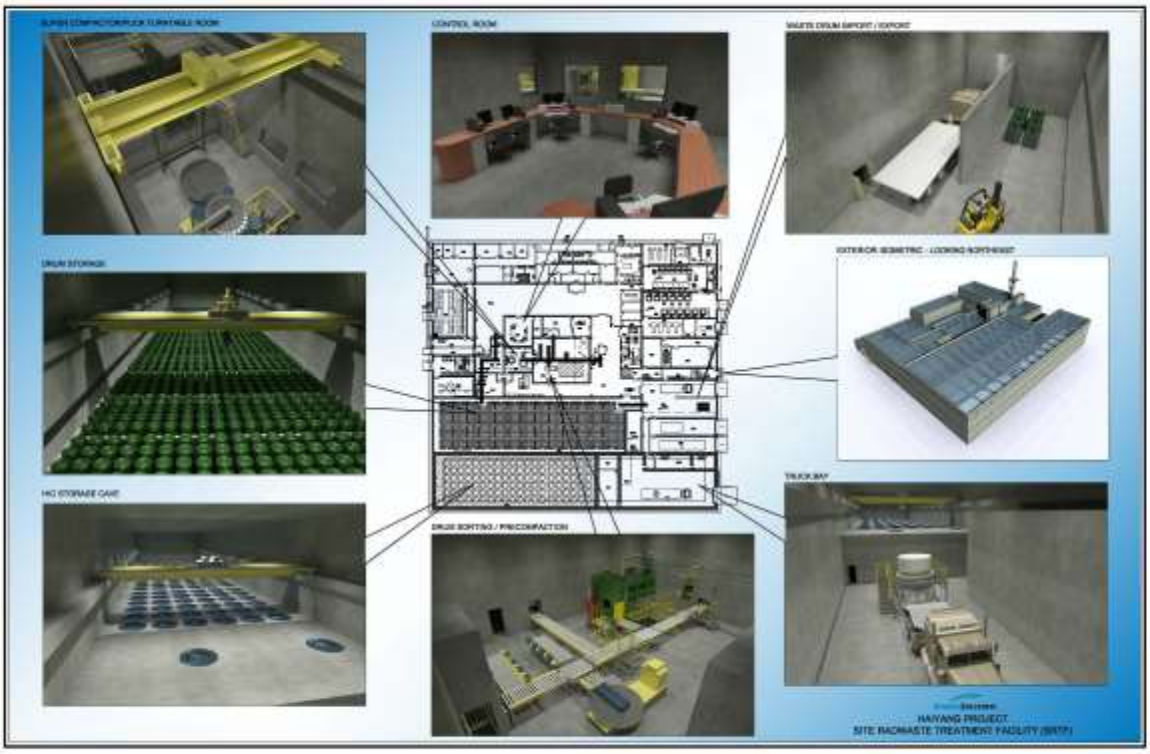

Figure 7 – SRTF schematic of component functions

The AP 1000 SRTF at Haiyang is now undergoing full commissioning and utilizes technology that employs the same secondary waste handling methods, equipment and processes as the Yangjiang CPR 1000.

5.0 SUMMARY

Energy*Solutions* has successfully transferred its 30 years of nuclear power plant waste management experience and technology to the growing Chinese nuclear new build program. Key projects, such as Yangjiang 3 and 4 CPR 1000's have seen this experience and technology be applied to target the lowest discharge limits for effluents from an operating NPP of 37 Bq/L. Additionally, Energy*Solutions* participation in the construction of the Site Radwaste Treatment Facility (SRTF) at Haiyang for the AP1000™ has seen the introduction of a holistic approach to waste management across multiple reactor types ensuring uniformity of secondary waste produced and commonality in the selection of technology and equipment. This holistic approach presents operational benefits and simplifies the waste management infrastructure required to process secondary waste to the point of final disposition.