

Equipment for RAW handling, packaging, transport and storage from ZTS VVU KOSICE a.s.

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Since 1988, the company ZTS VVU KOSICE has devoted a great part of its activities to the development of equipment for RAW handling, packaging, transport and storage, mainly for application in the decommissioning of NPP A1 at Jaslovské Bohunice in Slovakia. This is a HWGCR NPP shut down following a breakdown in 1977.

This incident was caused by disruption of the technological channel serving as a barrier between heavy water moderator and fuel assembly. Damage of this barrier enabled heavy water leakage into the primary circuit with partial fuel elements cladding damage and subsequent additional contamination of the primary circuit.

During two consecutive years after the incident main effort was focused on activities related to personnel and environment protection, moderator draining, reactor defuelling, dry cleaning of the primary circuit, repair and maintenance of equipment.

The next step was the preparation of the concept of NPP A-1 introduction into dry safe state. The order of importance of RAW liquidation was as follows:

1. Spent fuel – spent fuel assemblies from NPP A-1 were, after short cooling, stored temporarily in storage pipe containers filled at the beginning of NPP operation with “chrompik” (an aqueous solution of $K_2Cr_2O_7$ with concentration of 3-5%), later with “dowtherm” (mixture of bi-phenyl oxide and bi-phenyl). The containers were placed in a storage pond filled with water.
2. Liquid RAW – combustible (dowtherm, oils) and non-combustible (chrompik, Demi water, decontaminating solutions, sludge, sorbents, etc.)
3. Solid RAW – metallic and non-metallic

For this purpose, it was necessary to build RAW processing lines, intermediate storage facilities and systems for manipulation and transport of RAW.

The equipment for the above mentioned operations developed at ZTS VVU KOSICE can be divided into the following groups:

1. **Equipment for modification of spent fuel elements for safe transport**
2. **Intermediate storage facilities for spent fuel elements (dry and wet)**
3. **Intermediate storage tanks for liquid RAW**
4. **Containers for liquid RAW (up to $10^{11} Bq/dm^3$) including pumping and filling stations for these containers, as well as means for their transport on public roads**
5. **Robots and mobile telemanipulators for RAW handling, for accident survey and technological operations at decommissioning of NPPs**
6. **Equipment for metal RAW processing**

1 Equipment for modification of spent fuel elements for safe transport

Spent fuel rods contained in storage pipe containers with chrompik had to be prepared for transport to the processing plant in Russia. This meant perforating the pipe container in several places, draining the chrompik and hermetically enclosing the container. With regard to the risk of ignition of uranium in contact with the perforating tool, three-level fire protection was designed (spraying of water through the tool, creation of argon atmosphere and emergency



powder extinguishing system) with constant oxygen (O₂) and temperature monitoring in the working area, as well as evaluation of the perforating force course. Two cameras provided visual control. A control system evaluated each step of the operator and granted approval for the subsequent step. Altogether, 128 pipe containers with spent fuel rods were processed in the facility, at chrompik activity 10¹¹ Bq/dm³.

2 Intermediate storage facilities for spent fuel elements (dry and wet)

These storage facilities are used for spent fuel rods from operating NPP V-1 and V-2 at Jaslovské Bohunice (wet storage), or from NPP A-1 (dry storage).

The wet intermediate storage facilities are represented by stainless steel containers submerged in a pool filled with Demi water. Each container consists of 48 hexagonal pipes made from special stainless steel with increased contents of boron (1.15%).

The dry intermediate storage facility is made up of a metal, hermetically enclosed box container, 10 meters in height, with 130 large protective pipe containers, in which spent fuel rods are temporarily contained.

Temperature and chrompik level in the basic pipe container are monitored, as well as any possible leakage into the large container.



3 Intermediate storage tanks for liquid RAW

The NPN type storage tanks are designed for the storage of radioactive decontaminating solutions and chrompik. The stand-up cylindrical tanks have a domed bottom and flat lid. The tank shell is double; the outer shell is made of carbon steel and it has the function of an arresting tank in case of emergency. The inner shell is made of Class 17 steel and it is designed for storage of LRAW. The bottom part of the tank is fixed in a carrying beam structure; the top part is strengthened by a stabilizing grid. The grid carries a service platform accessible from a ladder. The top section is provided with inlet pipes with compensators, which connect the tank to the shielding platform. Ancillary equipment includes a mixer, immersion sludge pumps and emergency pumps, level gauges, leakage signaling device, pump for removing any leakage from the inter-sheet space, electrics, and operator's control panel. The available storage capacity is 3x25 m³.



4a Containers for liquid RAW

The containers for liquid RAW include various types of double-shell containers with shielding, suitable for transport on public roads and/or railways in accordance with the IAEA and ADR regulations.

According to the particular requirements, the container can include a pump, mixer, level and temperature gauges, trace heating device, nozzles for interior decontamination and remote control of individual functions. The configuration, volume and shielding of the container are dependant on the transported medium, i.e.

- Water solutions approx. 10^{11} Bq/dm³
- Viscous oils
- Bulk material, sludge, etc.



4b Pumping and filling stations

The pumping and filling stations are interconnected by piping systems with storage tanks and enable the pumping of the stored medium into the transport container (Item 4a), in which it is then transported to the processing plant. Both the tanks and the piping routes are double-shell, with leakage signaling feature. With regard to the high activity of the medium, special attention is paid to the prevention of leakage during container connecting and filling, as well as to the possibility of internal decontamination of the tanks.



5 Robots and mobile telemanipulators for RAW handling

Heavy duty column robots

ZTS VVU Kosice have supplied two heavy duty column robots to NPP Temelin for the French company SGN.

Robot control is hybrid – robotic and manual. The robots are applied in weighing, closing and transfer of drums from bitumenizing line carousel into shielding container. In view of the flowing properties of the active medium inside the drum, very special emphasis was placed on the continuity of robot movement.

Carrying capacity at maximum arm reach is 500 kg



MT15 Mobile teleoperator

The MT15 is a remote controlled, two-arm articulated manipulator with 5 degrees of freedom and carrying capacity of 15kg, based on a tracked chassis. It is designed for reconnaissance and for emergency intervention in case of breakdown. Besides manipulation, the exchangeable technological superstructures enable also the decontamination of surfaces, taking of samples by surface smearing, cutting, drilling and chopping operations, air monitoring as well as pulling out unconscious individuals from danger zone to safety.



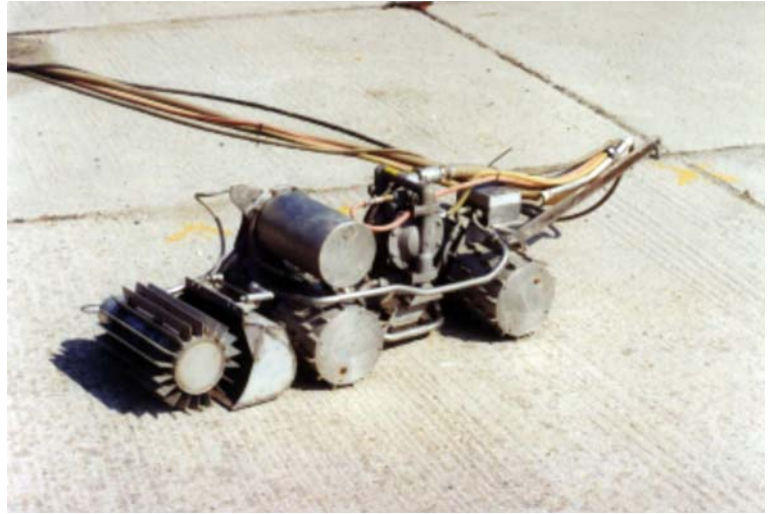
MT80 Mobile teleoperator

This is a more powerful manipulator with 6 degrees of freedom and a carrying capacity of 80kg. The hydraulic drives in the joints provide an exceptionally wide range of movements. The manipulator control is robotic, „teach-in“, or manual in the „master-slave“ regime. Control system allows high level of self-adaptivity for different geometrical shapes of cleaned surfaces.



Sludge crawler

This equipment is very useful helper for outer tank bottom cleaning and sludge removing.



5 Equipment for metal RAW processing

Pipe container processing equipment

This is a complex technological unit where 9 meter long pipe containers are cut into 200mm sections, pressed and filled into drums. Then the drums are closed and placed inside the shielding container, prepared for transport. Max. shearing force is 2000kN. All parameters of the process are fully controlled and visualized on the control panel.





Conclusion

Long-term experience in the development of RAW handling and processing equipment allows the ZTS VVU KOSICE engineers to provide complex solutions for NPP decommissioning also in applications involving a high level of contamination or in cases of accidents in NPP.