**LANNER**

WITNESS Modeling is key to securing contracts worth billions of dollars for EnergySolutions in Used Nuclear Fuel Recycling Facility Design

EnergySolutions, a world leader in the safe recycling, processing and disposal of nuclear material, have used WITNESS for many years and it is their preferred solution for process design, operations, decommissioning and planning. The use of WITNESS has been key to securing contracts worth billions of dollars.

This case study details a specific recent challenge that EnergySolutions faced to become an industrial partner in the US Government's initiative to study UNF Recycling and to develop a conceptual design for a UNF Recycling Facility. WITNESS modeling, including both 2D and 3D graphics helped illustrate how a baseline design needed to be altered to meet the capability required.
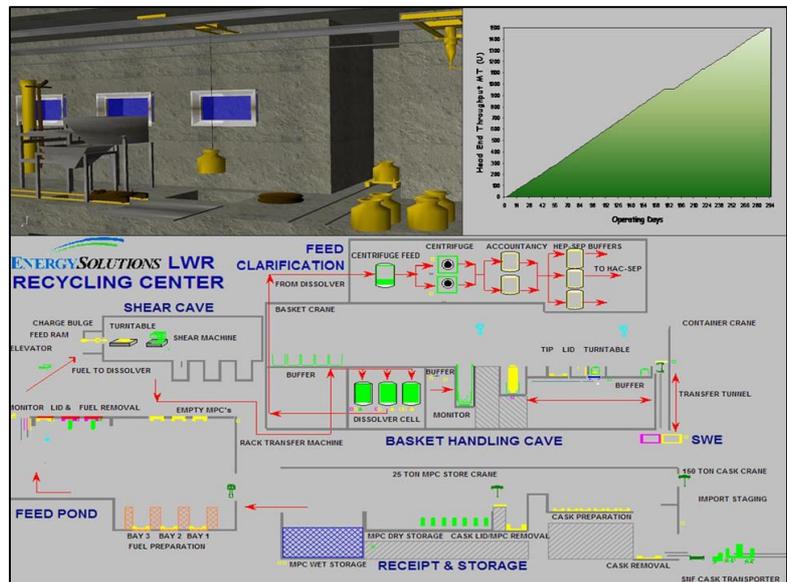
Picture of WITNESS 2D and 3D displays and an output graph from the model.

Joanne Berry, Principal Analyst at EnergySolutions, comments:

"WITNESS enables a complete understanding of nuclear operations and facilitates better and more efficient handling of processes. We bid on a lot of different types of work in the US and across the world. WITNESS is used as a key differentiator in proposals. We recently won a 10 year $7.3 bn project to handle high radioactive waste at the Hanford Site in Washington State and WITNESS modeling was key to us securing this business and proving our capabilities to the U.S. Department of Energy. WITNESS also helps to optimize the productivity of the project so that the skills gap, that often occurs within nuclear projects, is offset."

Company	EnergySolutions
Industry	International Nuclear Services
Application	Processing of Nuclear Waste
Benefit	Winning multi-billion $ contracts for Nuclear Waste handling

About EnergySolutions

EnergySolutions is an international nuclear services company with operations across the world. With over 5,500 employees, EnergySolutions is a world leader in the safe recycling, processing and disposal of nuclear material.

EnergySolutions provides integrated services and solutions to the nuclear industry, the United States Government, the Government of the United Kingdom, hospitals and research facilities.

Background

EnergySolutions provides a full range of services for the decommissioning and remediation of nuclear sites and facilities, management of used nuclear fuel (UNF), the transportation of nuclear material and the environmental cleanup of nuclear legacy sites such as the uranium mill tailings site in Moab, Utah. It owns and operates several state-of-the-art facilities including a metal melt facility in Tennessee and a low-level waste disposal facility in Utah.

Its projects are diverse and recent work has provided solutions for existing second generation nuclear facilities such as the Advanced Mixed Waste Treatment Plant in Idaho and the uranium-233 Downblending Facility in Oakridge Tennessee, and a project with Hanford Site to manage and close World War II era underground tanks containing liquid high level nuclear waste in a safe manner.

Stepping up to the Challenge

EnergySolutions faces a number of challenges in the competitive marketplace for nuclear services. In winning bids for a diverse mix of large scale contracts, it must demonstrate that its proposed approaches for the processing of nuclear waste are appropriate, its capabilities proven, and reliability and accuracy are assured. It must also prove without doubt that it can meet specified deadlines and comply with ever-changing legislation and be transparent at all times.

Joanne Berry, Principal Analyst at EnergySolutions comments:
"Compliance is a major issue as the goalposts in this area are constantly shifting. It is not currently US policy to recycle UNF but this may change as the benefits to carbon-free energy production of using the energy in UNF are increasingly recognized. Ultimately we need to have a very agile business model in order to be able to respond quickly and appropriately to changes in legislation."

One particular recent challenge that EnergySolutions faced was to become an industrial partner in the US Government's initiative to study UNF Recycling and to develop a conceptual design for a UNF Recycling Facility.

Launched in 2006, this initiative was developed in order to examine how UNF recycling could contribute in the future to the carbon-free energy needs of the United States.

In May 2007, the US Department of Energy (DOE) provided financial assistance to successful industry applicants to produce conceptual designs for UNF recycling facilities and advanced fast reactors in the United States. EnergySolutions led one of four teams awarded funding.

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Lanner helps organizations achieve rapid and effective business change. Based in the UK with subsidiaries and partners in Europe, the Americas and the Far East, Lanner works with more than 3000 of the world's leading companies.

Finding a Solution

EnergySolutions has used simulation modeling over the last 15 years to accurately predict throughput and performance of multiple new and existing nuclear facilities.

In developing its conceptual designs, EnergySolutions used WITNESS from Lanner to help develop a facility design based on mature, commercially deployed nuclear fuel recycling technology and operational facilities.

Using WITNESS, EnergySolutions performed a Conceptual Design Study for the proposed Nuclear Fuel Recycling Centre. The design encompassed the receipt and temporary storage of UNF from pressurized water (PWR) and boiling water (BWR) reactors. Head End fuel shear and dissolution functions were included, as well as downstream primary separations, purification and finishing functions, all downstream waste management facilities and supporting balance of facility plants. The 2D representation of the facility from the WITNESS model can be seen below.
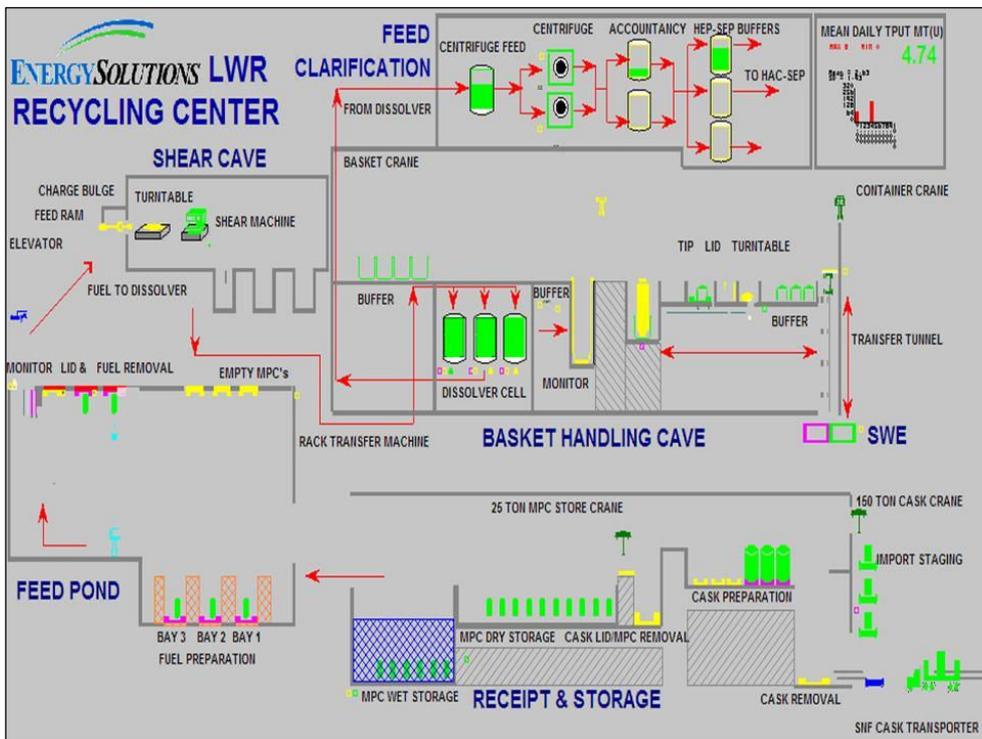
The WITNESS 2D Model display of the Head End Plant which including Fuel Receipt and Storage, Feed Pond, Shear Cave, Basket Handling Cave and Feed Clarification

Modeling provides an invaluable insight into how existing or new processes operate, taking into account all the constraints involved in the day to day operations of a nuclear facility. Through using WITNESS' modeling capabilities, EnergySolutions was able to predict facility throughput and identify key process bottlenecks within complex nuclear operational units.

By modeling the facility, EnergySolutions identified that the production target of 1,500 metric tones of uranium (MTU) per year could not be achieved with the existing baseline design. Therefore, several process improvements would need to be implemented in order to optimize throughput and performance.

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The Plant model was developed entirely using the WITNESS software. The model was underpinned by various conceptual design media including process descriptions, process flow diagrams, mechanical handling diagrams and mass balance calculations. The model also incorporates key operational experience from the reference Sellafield Thermal Oxide Reprocessing Plant (THORP) in the UK.

Through using WITNESS, EnergySolutions' was able to identify the design improvements required to meet the annual production target of 1,500 MTUs per year. In summary, these design improvements include:

- Doubling the capacity of the fuel removal machine, fuel elevator and shear machine such that 2 BWR assemblies can be processed at the same time.
- Reducing the dissolver vessel heat up times by 10%
- Allowing the Container Process Crane to substitute for the Dissolver Basket Process Crane operations during an outage and vice versa
- Providing an additional maintenance area in the cave to improve Dissolver Basket Handling Cave repair times
- Increasing the reliability of the Dissolver Control System, UNF Hulls Monitor, Hulls Tipping Machine, Fuel Removal Machine and Rack Transfer Machines

When each of the proposed improvements are implemented, facility throughput can be increased by as much as 86%. These improvements, together with the lessons learned from previous plant operations at the THORP in the UK, have been incorporated into the facility design to ensure the annual target throughput of 1,500 MTU can be achieved.

WITNESS modeling was key to EnergySolutions, giving the client confidence in the conceptual design as it enabled process design and improvements to be clearly mapped out, outcomes assured and the design to be spelled out in detail.

For this project, EnergySolutions also used the 3D modeling capabilities in WITNESS in order to demonstrate the process planning in a format which is easy to understand.
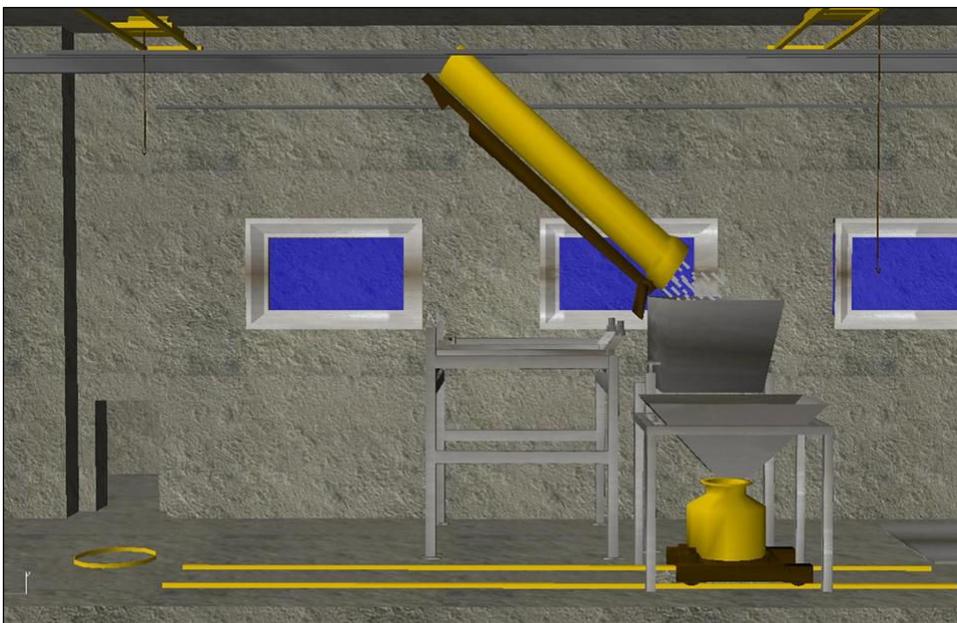
WITNESS VR - 3D Model of the Basket Handling Cave showing a basket of hulls being tipped into a hulls container

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Joanne continues:

"It's never too early in a project to develop simulation models and the effort required and return on investment should not be underestimated. Early model development identifies restrictions to facility throughput and operability at a time when the issues are easily resolved and the cost impact is less."

"WITNESS helps EnergySolutions to identify whether briefs and deadlines can be met at the outset of a project and where improvements to process design can be made to make the process faster and safer."

Conclusion

Joanne concludes:
"We have used WITNESS for over 12 years now. While we use a few other simulation packages for modeling new and existing nuclear facilities, WITNESS is our preferred solution for process design, operations, decommissioning and planning.

"WITNESS enables a complete understanding of nuclear operations and facilitates better and more efficient handling of processes. Simulation is not used commonly in the US nuclear industry but our experience of the Sellafield Site in the UK had already proved that it is an integral tool in proving a business case in the field.

"We bid on a lot of different types of work in the US and across the world. WITNESS is used as a key differentiator in proposals. We recently won a 10 year $7.3 bn project to handle high radioactive waste at the Hanford Site in Washington State and WITNESS modeling was key to us securing this business and proving our capabilities to the U.S. Department of Energy. WITNESS also helps to optimize the productivity of the project so that the skills gap that often occurs within nuclear projects, is offset.

WITNESS modeling is a key element of our business operations and our strong relationship with Lanner means that we can provide feedback into development of WITNESS. Lanner is very much a partner rather than a supplier."
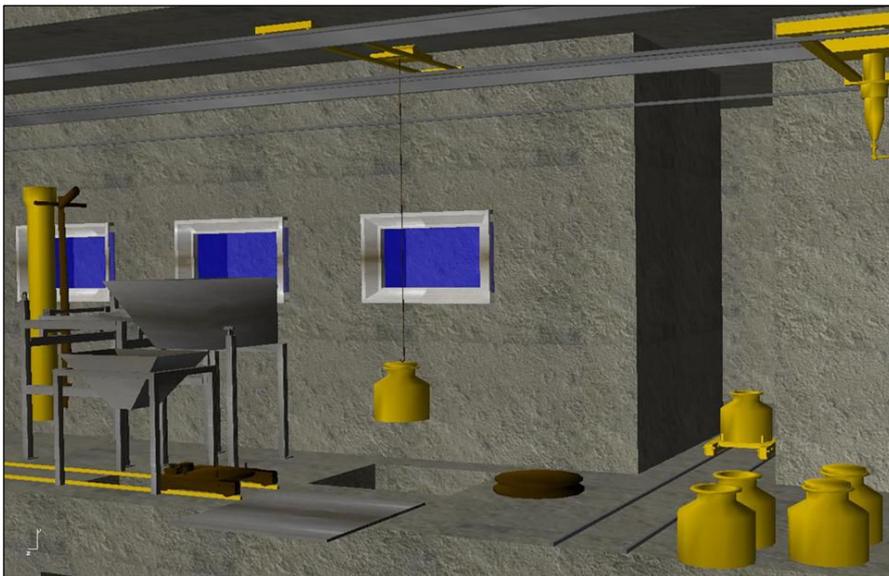
WITNESS VR - 3D Model of the Basket Handling Cave showing a hulls container being exported using a crane.

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