Lawrence Livermore National Laboratory

Relies on ENOVIA as it tackles pressing energy and nuclear operations challenges

Overview

■ **Challenge**
Manage the configuration of hundreds of thousands of documents and critical processes for multiple complex projects that can span decades.

■ **Solution**
ENOVIA currently provides 1,600 users complete configuration management capabilities for all engineering, design safety and compliance data and processes, in compliance with exacting US Department of Energy (DOE) regulations.

■ **Benefits**
Throughput in handling engineering records increased six-fold; engineering changes processed five times faster; BOMs created automatically in ERP; bids and quotes that once took a week to assemble now compiled in less than a day.

"ENOVIA Engineering Central is at the core of our Enterprise Configuration Management System."

Bernie Merritt, NIF Configuration Management and Integrations Manager, Lawrence Livermore National Laboratory

### Innovative research for advanced energy solutions

Lawrence Livermore National Laboratory (LLNL), a US Department of Energy (DOE) Research and Development facility, pursues research projects ranging from energy independence and environmental protection to national and nuclear security. Backed by a wide variety of support disciplines, teams of scientists pursue technical innovations and scientific breakthroughs and help apply those discoveries to pressing, real-world challenges.

One such project is the National Ignition Facility (NIF), where legions of scientists, engineers, technicians and designers have developed the world's largest laser system. At least 60 times more powerful than any previous laser, NIF will direct 500 terawatts (a thousand billion watts) of light at a nugget of frozen hydrogen isotope smaller than a pea. Temperatures greater than 100 million degrees Celsius will start a nuclear fusion reaction – the same process that makes stars shine – and release up to 20 times more energy than that used by the laser.

The technology could be applied to create fusion-driven power plants to generate vast amounts of inexpensive electricity from a virtually limitless supply of clean-burning, common hydrogen fuel, with no greenhouse gases or radioactive waste. Such plants may one day use nuclear waste as fuel, safely turning it into harmless dust. NIF recently demonstrated the ability to focus the high-energy laser onto a target, with plans to achieve fusion ignition in 2010 – a feat never before accomplished. Practical use of the technology for power plants could follow in about ten years.

Challenges of a Vast R&D Facility

As one of the most ambitious projects ever undertaken at LLNL, NIF faced significant challenges in managing massive stores of data associated with the project – especially regarding equipment design and safety protocols for the system's nuclear materials and radiation levels. This included data for current work as well as tens of thousands of legacy documents from the previous ten years – plus hundreds of thousands more to be generated throughout the expected 30-year NIF lifecycle.
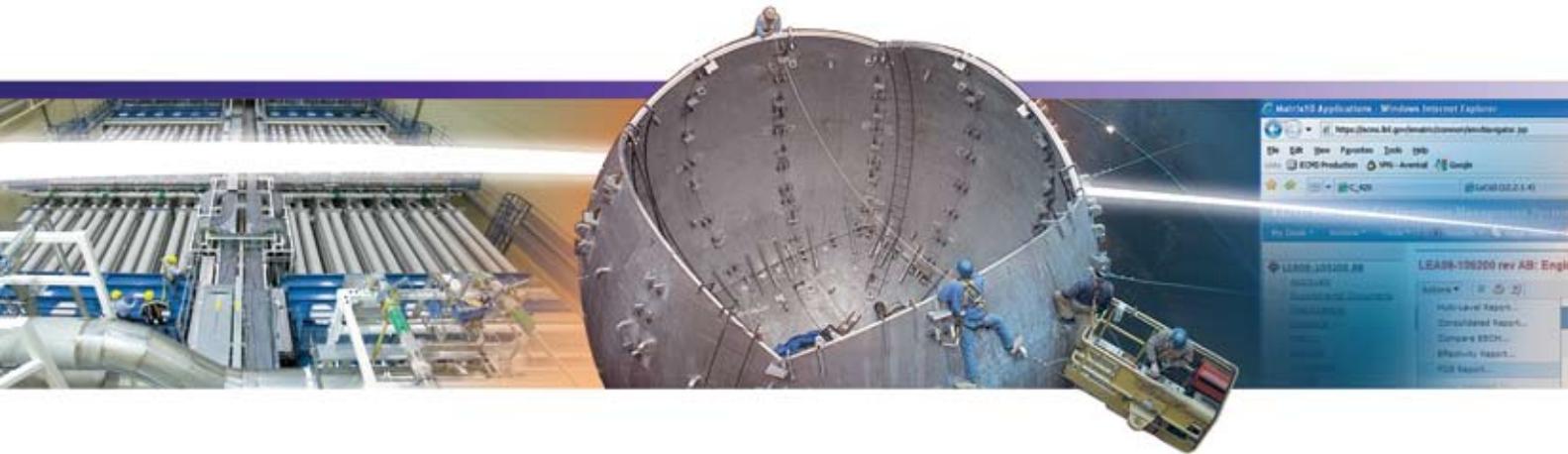
DASSAULT SYSTEMES

LLNL's manual, paper-based system lacked controls mandated by the DOE. Specifically, DOE requires nuclear facilities to establish and maintain consistency between documentation of design requirements and physical configuration throughout the lifecycle, especially as changes are being made. LLNL nuclear programs such as the Joint Nevada Program Office (JNPO) and Nuclear Materials Technology Program (NMTP) faced similar challenges in managing documents for equipment design and nuclear safety.

Single Version of the Truth

This daunting task was addressed with an Enterprise Configuration Management System (ECMS) based on Dassault Systèmes ENOVIA Product Lifecycle Management (PLM) solutions. With more than 1,600 users throughout LLNL, ENOVIA Engineering Central provides a single digital source of information, consolidating all engineering data and processes in an integrated enterprise solution across the complete product lifecycles of various business units. By controlling CAD models from which many other documents are derived, the system effectively ensures that all related documents reflect all revisions. Pioneered by NIF, ECMS is now used by eleven other LLNL business units, including LLNL work at the Nevada Test Site.

"We're not just controlling drawings and documents – or archived pictures of them – but managing the underlying data within the CAD model, including dimensions, materials, tolerances, part numbers, test measurements, analysis results, and safety regulations," says Bernie Merritt, NIF Configuration Management and Integrations Manager. "By managing this source data, we maintain strict control over data and processes required by DOE regulations."

Stewardship of Taxpayer Resources

With the total cost of NIF at $3.5 billion, DOE and Congressional reviewers maintain close oversight of funding, especially in light of a desire for increased transparency into how tax dollars are spent.

"In addition to details of our day-to-day procedures, the system provides a granular overview of productivity and the overall progress of the project in monthly status reports to the DOE," says Frank Papp, NIF CIO. "By providing well-managed, disciplined process controls and measurable efficiency gains, the system demonstrates our ability to meet major project milestones within a fixed budget and available resources."

Broad Scope of ENOVIA

"ENOVIA was selected based on numerous factors, but certain capabilities are particularly well-suited for ECMS," says Michael McDaniel, PLM Process Leader and Engineering Records Center Manager.

Ease of use is critical to ensure quick training and greater productivity, especially given the matrix organizational structure in which personnel from various disciplines at LLNL move in and out of projects as needed. Out-of-the-box functionality with configurable solutions helps adapt the system to particular LLNL processes. Tight integration with other software supports external business systems required for electronic data transfers among downstream processes.

"Integration hooks between software applications in widely dispersed areas of LLNL are absolutely essential in the enterprise-wide scope of ECMS," McDaniel says. "Without such integration, the data would only be retrievable through the ERC in engineering."

Enterprise-Wide Efficiency Gains

"By allowing the organization to streamline work processes and leverage design data, ECMS has increased operational efficiency in engineering processes such as records management, engineering changes, and bill of material generation, as well as downstream procedures in groups outside of engineering, including those in ERP and Procurement," McDaniel says. "As the data-driven engine of ECMS, ENOVIA Engineering Central has resulted in significant enterprise-wide efficiency gains."

At the LLNL Engineering Records Center (ERC), documents are stored for long-term retention per DOE and National Archives Records Administration (NARA) guidelines. In the former manual process, considerable time was spent printing hard copies, creating film images, checking image quality, acquiring signoffs, filing and other tasks. Integrating ENOVIA Engineering Central with the ERC process automated many of these steps, increasing ERC throughput by six times – from 15 documents per day to more than 100 per day.

Similarly, five-fold productivity gains were achieved in processing engineering change requests (ECRs) and engineering change orders (ECOs). Documents are now routed electronically based on detailed workflows in ENOVIA Engineering Central. ECRs and ECOs that formerly took up to a week to process can now be completed in a day. Moreover, review capabilities are enhanced by displaying all areas of the design impacted by changes so conflicts can be resolved earlier. Configuration management ensures correct revision levels at all times.

According to Ed Krieger, PLM Strategist at NIF, "some of the greatest gains in productivity and accuracy have been achieved in the creation and handling of bills-of-material (BOMs)." In the manual process, designers would type relevant information onto a parts list, and production personnel would retype the data into NIF's enterprise resource planning (ERP) system. "By automatically extracting BOM data directly from Engineering Central into ERP, we eliminated substantial workload and potential for error. Now we have no duplicate keystrokes, no risk of typos, no missed parts and no delays," Krieger says. "Whereas the manual process took days, electronic transfer of BOM data from PLM to ERP is now automatically initiated at drawing release and completed within seconds."

BOM data is automatically transferred to the LLNL procurement system, along with information on suppliers and part specifications. Instead of taking a week or more to manually assemble hard copies, support documents for bids and quotes are accessed electronically through an online job order process, usually completed in less than a day. Similar gains are made in an automated warehousing system that receives up-to-date parts and materials information directly from ENOVIA Engineering Central.

"The enormous scope and complexity of LLNL contract requirements demands a PLM system with advanced features and capabilities."

Michael McDaniel, PLM Process Leader and Engineering Records Center Manager, Lawrence Livermore National Laboratory

PLM Footprint Expands at Livermore

With the success of the NIF pilot project, word spread to other LLNL projects that also required configuration management and change control processes.

Nuclear materials are developed at LLNL's Super Block Facilities, where configuration management and change control are mandated by the DOE and the Defense Nuclear Facilities Safety Board (DNFSB) for operating procedures, safety plans, surveillance processes, equipment descriptions and other critical documents and procedures to ensure worker and public safety.

"Workflow for the review and approval of these documents is now managed by ENOVIA Engineering Central with current revisions accessible online," says Chris Holm, Nuclear Materials Technology Program deputy program leader for Facilities Operations. "The facilities can readily demonstrate configuration management of these documents and processes to assessment teams by presenting document logs, revision histories and other relevant compliance records, validating that safety regulations are being maintained and fulfilling vital licensing requirements."

"Configuration management requirements also are being met using ENOVIA Engineering Central for LLNL work at DOE's Nevada Test Site, where experiments with conventional explosives gather material properties data on nuclear materials to develop and verify simulations for determining how aging nuclear weapons materials would behave if used today," says Patrick Dohoney, JNPO Control System Engineer. Such sub-critical experiments are an integral part of safely maintaining the nation's nuclear weapons arsenal without the use of nuclear testing, which the United States ended in September 1992.

On the Horizon

With support from various programs like JNPO, the Nevada Test site plans to develop a common control system for safety, interlock, control, timing, firing and monitoring for the many different facilities there. Managed by ENOVIA Engineering Central, this vast engineering project would eventually standardize these operations at LLNL test sites.

This broadening use of ENOVIA Engineering Central is typical across LLNL, where PLM technology is expanding in many areas. Productivity enhancements continue to be made through optimized processes, increased levels of task automation, and greater use of custom workflows. Planned LLNL PLM implementations include concept studies and risk assessment activities. Opportunities are being explored for extended enterprise integrations with government agencies, suppliers and development partners.

"As our research efforts move into the future, we must rely on the state-of-the-art technology and process control that continues to be built into ECMS," says Darwin Dobson, PLM Enterprise Manager at LLNL. "The enormity of such an undertaking demands innovative capabilities to manage huge volumes of information and complex processes. Without the capabilities of state of the art PLM systems, such a project would not be practical."

"PLM helps provide a means for us to reach the full potential of far-reaching energy initiatives that will unfold in the coming decades. Without these capabilities, such a project would not be practical."

Darwin Dobson, PLM Enterprise Manager, Lawrence Livermore National Laboratory

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