

# SOUTHERN CALIFORNIA EDISON

Extending nuclear plant life with V5 PLM





## SONGS Objectives

- *Plan major nuclear plant upgrades to ensure feasibility*
- *Minimize length of \$1 million per day maintenance outages*
- *Minimize worker risk during complex maintenance procedures*
- *Validate work contracted externally*



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Steve Stephens, CATIA V5 and ENOVIA SmarTeam administrator, SONGS

## Company Overview

San Onofre Nuclear Generating Station (SONGS) is the largest generator of electricity in Southern California, serving 2.75 million homes and providing 20 percent of the total power Southern California Edison (SCE) provides to its customers. The two-reactor facility was built in the 1970s and licensed to operate through 2022. But growing demand for electricity and a lack of replacement capacity prompted SONGS to upgrade its plant equipment, paving the way for Edison officials to apply for a license extension that would allow the plant to produce power through 2042.

## Business Challenges

### Extending the life of nuclear power plants

Accomplishing equipment upgrades at a nuclear power plant is no easy task, requiring maintenance operations the original designers never allowed for during construction. Among these, SONGS must replace its four 621-ton steam generators, which measure 65 feet (20 metres) by nearly 20 feet (6 metres) – larger than many houses and double the size of the steam generators used at most nuclear plants. The work is scheduled to continue through 2010 at an estimated cost of US\$680 million.

The plant was built with a design intended to last for the entire 40-year operating license, so some of the components – like the steam generators – were not designed with replacement in mind. “They were installed and the concrete enclosure was built around them, said Steve Stephens, CATIA V5 and ENOVIA SmarTeam administrator for SONGS. “We will have to cut a rather large hole through the containment building wall just to open a pathway to replace them.”



Each day of downtime costs SCE about US\$1 million due to the cost of purchasing replacement power at 4 cents per kilowatt. To ensure success, SONGS must accurately predict every facet of the operation, from how much weight the polar crane used to lift the steam generators will hold, to which pathways provide enough clearance to move the massive generators to and from the plant. Any unanticipated surprises could cost the company millions of dollars and create power shortages in SONGS's service area.

#### **Proving the concept with thimble rod simulation**

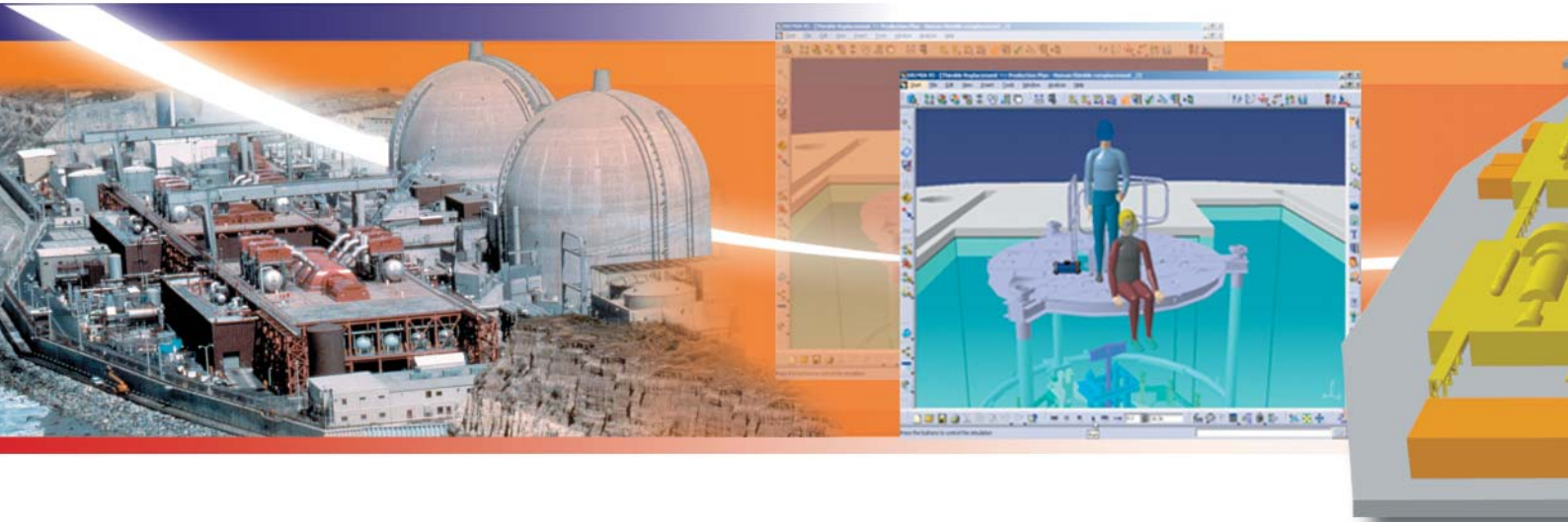
To prove that digital simulation with Dassault Systèmes Version 5 Product Lifecycle Management (DS V5 PLM) is up to the task of planning the steam generator replacement operation, SONGS officials decided to digitally simulate a similarly complex project scheduled for 2006 – replacement of the thimble rods that carry performance data to the control room from deep inside the nuclear core.

SONGS officials were among the first in the nation to recognize that, due to normal thermal growth in the plant's thimble rods, the rods no longer fit as they did when the plant was new. The thermal growth was causing fit-up challenges that meant the thimbles would need to be replaced. The condition has since been documented in ten other reactors. Since the rods are radioactive and submerged in a pool of water, replacing them required the use of divers who can only work in limited shifts to manage their radiation exposure. Ensuring the safety of the divers, combined with the US\$1 million per day cost of purchasing replacement power while the plant is out of commission, requires flawless execution of the project.

“3D digital simulation with CATIA V5 and DELMIA helps to ensure most variables have been anticipated and validates that tasks can be accomplished in the time allotted with the staff and equipment available.”

Steve Stephens, CATIA V5 and ENOVIA SmarTeam administrator, SONGS





“V5 PLM helps us collect as much data in a virtual project as in a real life one – even for operations conducted underwater.”

Steve Stephens, CATIA V5 and ENOVIA SmarTeam administrator, SONGS

## Solution

V5 PLM tools – CATIA, DELMIA, and ENOVIA (ENOVIA VPLM and ENOVIA SmarTeam) from Dassault Systèmes – were used to create digital models of SONGS’s facilities. These models were used to simulate the activities involved in replacing the thimble rods. The simulation was done in parallel with traditional “mock-up and planning methods” to test the concept of using virtual simulations in future SONGS projects.

### Complex operations simulated in DELMIA

DELMIA provides powerful simulation capabilities, allowing designers to bring time and motion studies into the project planning. The simulation of a diver cutting the thimble rods allowed SONGS to validate the use of DELMIA for planning, procedures, schedules and budgets and showed how it could potentially identify roadblocks, even when a complex operation is being conducted for the first time.

### Realistic 3D modeling in CATIA V5

Working from models originally created in CATIA V4, SONGS uses CATIA V5 to create accurate 3D digital models of the facilities slated for upgrades. The CATIA V5 models allow SONGS to anticipate every obstacle in replacing the thimble rods or moving the generators – from cutting a hole through 4-foot-thick (1.2 metre) concrete to gain access to the units, to relocating the massive numbers of electrical cables that cross the space where the hole will be cut.

### ENOVIA VPLM manages, organizes data

ENOVIA VPLM is used to manage the relationships between data. ENOVIA DMU helps SONGS to visualize complex operations with full 3D representations and fly-through capabilities that allow assemblies to be viewed from every angle. ENOVIA VPLM also applies restraints and standards to alert design engineers to clashes or inadequate clearances.



### **ENOVIA SmarTeam manages documents over long periods**

SONGS uses ENOVIA SmarTeam to track all of the components in the digital models, as well as the derivative 2D drawings and drawing changes for construction work. “We may make several changes to a drawing, but it may be years before the work is actually scheduled,” said Steve Stephens, CATIA V5 and ENOVIA SmarTeam administrator for SONGS. “We rarely work the engineering changes in the order they were issued. ENOVIA SmarTeam is our data management system of the future. It will help keep everything organized.”

## **Results**

### **V5 PLM ensures feasibility of complex, one-chance projects**

SONGS used traditional predictive techniques to plan replacement of the thimble rods in Unit 2. In a parallel effort, DELMIA was used with virtual 3D manikins and CATIA V5 digital models managed in ENOVIA and SMARTEAM.

“We wanted our test to show whether we could gather as much data virtually using V5 PLM as we could in actual practice, even underwater, and I think we showed that could be done,” Stephens said. “Using V5 PLM, we even identified some gaps in the processes for Unit 2 and were able to suggest revisions.”

Benefits of digital modeling with V5 PLM include:

#### **Proven feasibility studies**

3D digital visualization in ENOVIA VPLM and simulations in DELMIA allow SONGS officials to verify the feasibility of complex or dangerous tasks before they are attempted. “When we replace the steam generators there is no chance to practice,” Stephens said. “Virtual mockups in V5 PLM will help us get it right the first time.”

## **V5 PLM Key Benefits**

Digital mockup and simulation with V5 PLM validates the feasibility of complex, one-chance projects.

Fully simulating projects with V5 PLM results in verifiable schedules for on-time, on-budget completion.

V5 PLM quickly and cost efficiently tests different scenarios to arrive at an optimum solution.

V5 PLM can be used to validate the proposals of outside contractors and train workers.



### **Verifiable scheduling and budgeting**

Outages cost SONGS US\$1 million per day due to the cost of purchasing replacement power, so work must be completed on schedule. 3D digital simulation with V5 PLM helps to ensure most variables have been anticipated and validates that tasks can be accomplished in the time allotted with the staff and equipment available.

### **External contractor proposal verification**

Most contractors in the power industry use more traditional tools to plan their projects. “V5 PLM gives SONGS the opportunity to quickly and affordably verify our contractors’ proposals,” Stephens said. “We’ve already modeled a good bit of the new steam generator, validating the data from the engineers who are designing it.”

### **Ability to test different scenarios**

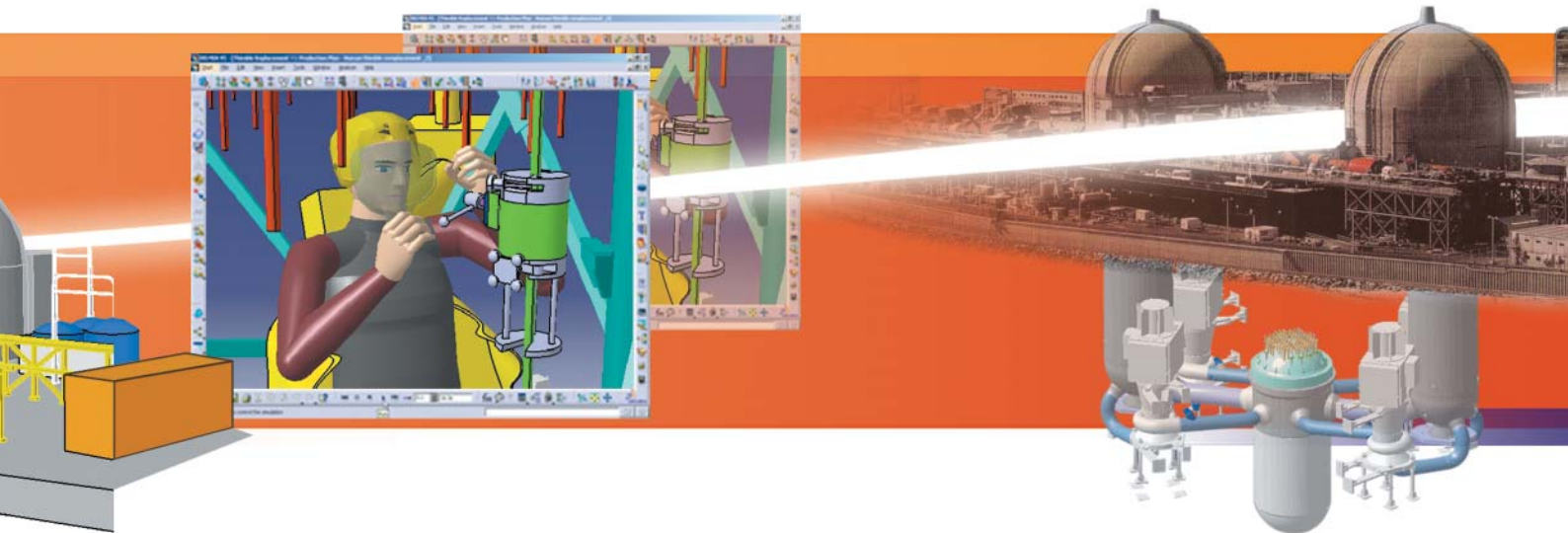
“We refuel during every outage. We plan to do simulations of many of our standard outage tasks, as well as time/motion studies on assorted tasks, to show us if we’re doing those as efficiently as possible.”

### **Training**

“We used some of our models and simulations for training when we were replacing the generator output terminal box for each unit. Those parts were as big as this room. We were able to show the workers what to expect and walk through a simulation of the job.”

“Doing whatever possible to reduce risk to the workforce and protect plant equipment are top priorities at SONGS. V5 PLM helps us accomplish that.”

Steve Stephens, CATIA V5 and ENOVIA SmarTeam administrator, SONGS



## Future

“Our Design Group considers V5 PLM vital to the future of SONGS,” Stephens said. “Our vision is to expand these capabilities until they encompass everything we do and then to share our models throughout the plant – with engineering for analysis, with procurement to order parts, with the operations group, with training and with construction. The applications are almost limitless.”

“We refuel every 18 months. You’re not sharp when you do something so infrequently. But the software remembers what we learned.”

Steve Stephens, CATIA V5 and ENOVIA SmarTeam administrator, SONGS

## V5 PLM FOR THE PROCESS, POWER AND PETROLEUM INDUSTRIES

**Dassault Systèmes provides comprehensive PLM solutions to allow owner operators, engineering procurement and construction companies, and equipment suppliers in the Process, Power and Petroleum industries to plan and execute end-to-end lifecycle management and maintenance of their assets.**

DS V5 PLM solutions cover the design, construction, maintenance and monitoring requirements of sectors

including oil and gas, chemicals, utilities and power, metals and mining, pharmaceuticals and life sciences, pulp and paper and food processors.

The DS V5 PLM portfolio of CATIA, DELMIA, ENOVIA, and SIMULIA enable PP&P companies to design facilities, simulate complex construction and renovation scenarios, validate schedules and budgets and check the feasibility of proposals submitted by outside contractors. From laying out

pipework and raceways to creating functional definitions of activities and assets, DS V5 PLM is a powerful new tool in the PP&P arsenal.

**For more information about DS V5 PLM solutions for the PP&P industry, visit [www.3ds.com](http://www.3ds.com)**

The Dassault Systèmes home page can be found at [www.3ds.com](http://www.3ds.com)

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The Dassault Systèmes V5 PLM offering consists of CATIA V5 for designing the virtual product, DELMIA for virtual production, ENOVIA for global collaborative lifecycle management (including ENOVIA VPLM, ENOVIA SmarTeam, and ENOVIA MatrixOne), and SIMULIA for virtual testing.

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