



TEKLA® Structures



TEKLA STRUCTURES IN PRACTICE:



**NESTE OIL
DIESEL PRODUCTION LINE**



TEKLA Structures

FULL STRUCTURAL DESIGN AND PROJECT MANAGEMENT IN ONE ENVIRONMENT

> The Diesel project at Neste Oil's refinery in the town of Porvoo is the first building project in which structural design incorporating concrete structures has been implemented from start to finish using 3D product modeling. Intelligent data transfer between systems enabled parallel progress in plant and structural design. The project also saw the creation of a joint design environment for use by several design firms based on the Tekla Structures system.



> The Diesel project at Neste Oil's Porvoo refinery entails building a new production line comprising a residual oil unit and hydrogen unit. Significant extensions and modifications are also being implemented in the refinery's existing process units and infrastructure. With the new production line, which is due for start-up at the end of 2006, Neste Oil will gain the capacity to produce increasingly clean motor fuels from heavier and more sulfurous crude oil than before.

With a volume of close to 600 million euros, Neste Oil's refinery investment is a significant ongoing building project. Engineering and contracting work for the project will total an estimated 1.5 and 3 million hours respectively. 25 hectares have been cleared for the project, around five of which will be occupied by the actual process area. New buildings covering almost 13,000 square meters will be built and approximately 19,000 cubic meters of concrete and 5,000 tons of steel will be used in the project as a whole.

Neste Jacobs, an affiliate of Neste Oil, is responsible for the Diesel project's engineering, procurement and construction. The design stage was launched in autumn 2003 and at its peak has employed more than 400 people at Neste Jacobs and several Finnish engineering offices.



MODELING AND MANAGING IN 3D

> Plant design has been implemented using 3D modeling tools since the early 1990s. In Neste Oil's Diesel project there was strong motivation to take structural design comprehensively into the 3D era while enabling data transfer between stakeholders in a maximally intelligent format. 3D modeling was exploited starting from the underground pipes and structures upward in the first ever project to also model concrete structures entirely in 3D, including the reinforcements and cast-in embeds. The models were used to produce general drawings as well as those required for steel, element and cast-in-situ concrete fabrication and the related lists. 230,000 components were modeled and 9,800 drawings together with hundreds of reports were produced for a range of needs.

"Even though structural design represents just 0.4% of the Diesel project's total costs, linking it with the plant design has been vital to the project's success. Data communication between systems has made it possible for plant and structural design to advance in parallel," describes Section Manager **Matti Sainio** from Neste Jacobs.

Neste Oil mandated 3D modeling based design for the entire Diesel project. Tekla Structures was selected as the structural design tool and a software environment jointly developed by four companies – Neste Jacobs, JP-Kakko, SWECO PIC and Consulting Engineers Pöysälä & Sandberg – was created based on the Tekla system.

"The idea was to incorporate steel and concrete structures in the same model. Tekla Structures was already familiar to steel designers but a new tool to all those working in concrete design. The project must have had its pressures when it came to training the personnel and progressing according to the timetable. Even so, a tight schedule has been a force for change in one clean sweep, which is a positive step for the future. A lot of work was done during the project to adapt Tekla Structures for the Finnish concrete building industry," Sainio explains.

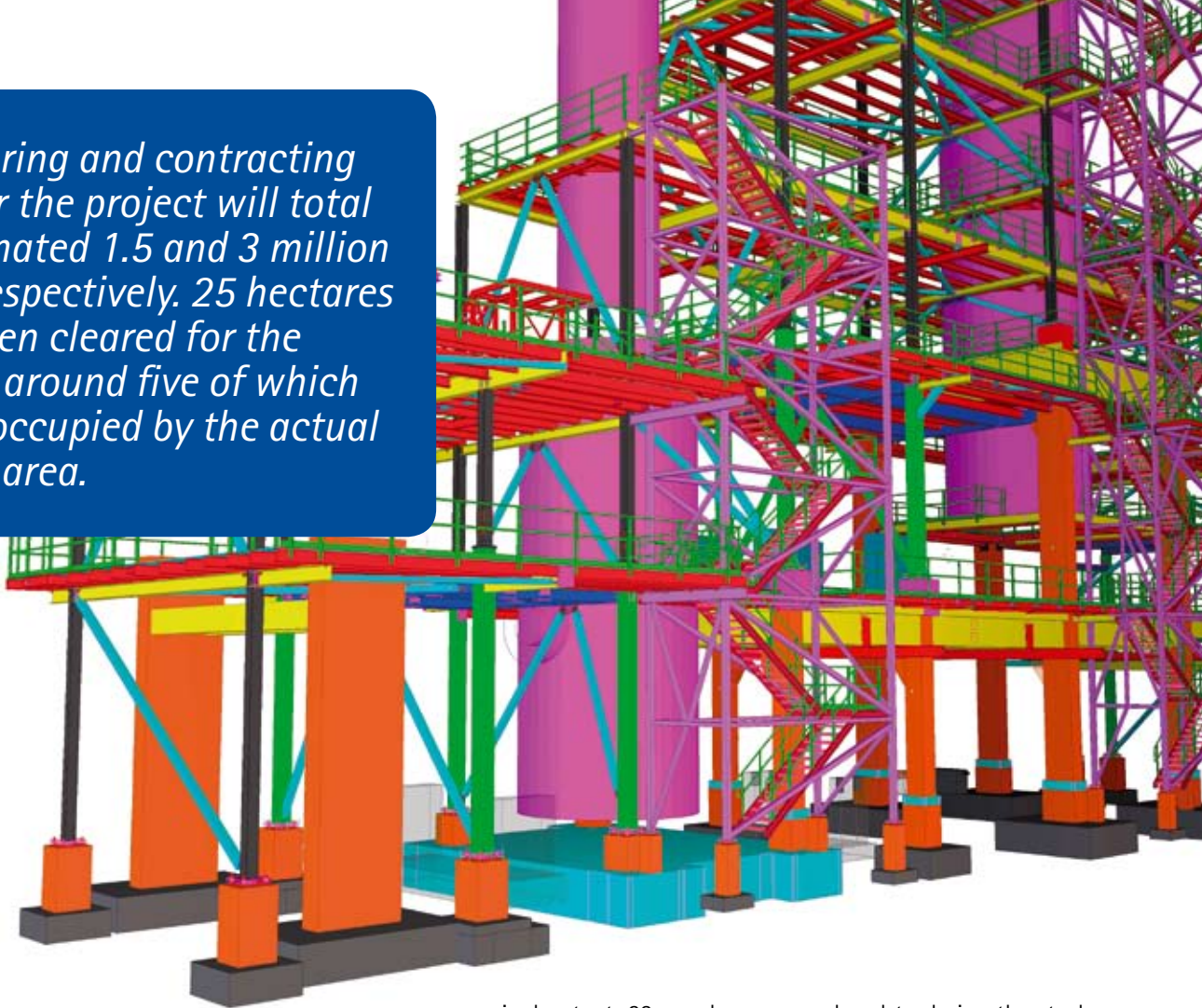
IMPROVING THE QUALITY OF DATA

> The Diesel project set ambitious objectives for the collaborative use of models and the quality of data content. All structural designers worked using the same multi-user modeling databases in the Tekla Structures environment. The project's size and the number of stakeholders made it practicable to divide the object into more localized 3D models. For data transfer between plant design and structural design, the 3D MicroStation file format was chosen to communicate steel and concrete structure geometry to the plant viewing models.

"We initially set higher aims for data transfer but due to the schedule decided to go with a tried and tested solution. Richer data transfer would have enabled genuine collaboration between the plant and structural designers," comments **Markku Eerikäinen**, Manager, Information Management at Neste Jacobs.



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Particular areas of development in structural design were collision detection and pipe support design. In total 12,000 tons – or approximately 200 kilometers – of pipe will be fitted during the project, some fabricated abroad from costly special materials.

"Efficient collision detection during the modeling stage has saved a lot of time and money. The same benefits were sought by modeling the pipe supports with real structures. This has made it possible to prefabricate the steel structures' secondary supports rather than fabricate onsite," Eerikäinen describes.

"Overall we wanted to focus on data quality. In addition to a graphic presentation, 3D modeling produces extensive object data. It's not enough that the drawings simply look correct – for future needs, the data stored in the database has to be accurate too."

A SUCCESSFUL CONCRETE PROJECT

> The responsibilities of the design firm JP-Kakko in the Diesel project have included the structural design for the residual oil and hydrogen units. All structures, steel and concrete, have been designed from start to finish with Tekla Structures. The system has been used to produce all the re-

quired output. 29 people were employed to design the steel structures and eight for their concrete counterparts.

"Tekla Structures has been in use for a long time with steel, and from the steel perspective the project has been implemented with normal performance figures. The concrete structural design actually went better than anticipated. A particular novelty in this project was the reinforcements. The concrete structures were designed within the same timeframe and with the same resources as with a traditional 2D system, which is quite an accomplishment with a new tool," assesses Design Manager **Heikki Solarmo** from JP-Kakko.

The design work employed traditional design data, i.e. structural design and construction information drawings. The hydrogen unit also called for an extensive use of piping and equipment reference models.



"As the project advanced our designers accumulated a lot of experience and developed the consistency of their work for future projects. Compared to previous projects, the component suppliers' libraries that allowed us to pick up parts of the correct shape and dimension were a significant step forward. Fabricating the concrete foundations went really well," describes Project Manager **Arto Malmström** from JP-Kakko.

FEWER PROBLEMS ON CONSTRUCTION SITE

> SWECO PIC's role in the Diesel project's structural design covered connections linking the plant's processes and the steel and concrete structures related to the sulfur chain sub-project including machine foundations, pipe bridges and work platforms. Some of the structures are located outside the actual process area, others are connected to existing processes. Many of the structures contained modifications to the refinery's existing systems or were connected to them, raising the level of challenge in design.

"For SWECO PIC, the Diesel project has been a significant initiative encompassing several areas of design, and in 3D concrete design Tekla Structures proved to be an efficient and functional tool," says Assistant Competence Center Manager **Guido Vakker**.

In Vakker's opinion, the option to view equipment and pipe models in the design model provides excellent prerequisites for an error-free and cost-efficient result.

"An additional benefit of a 3D design environment is that future plant users are able to familiarize themselves with the plant in advance using a DRW viewer as well as discuss the solutions," Vakker points out.

Consulting Engineers Pöysälä & Sandberg designed several of the buildings in the process area, including two distribution substations, an instrumentation facility, storehouses and a cooling water facility. The steel and concrete cooling water reservoir is a hundred meters long, 30 wide and 30 deep.

"We've designed steel as well as cast-in-situ and element concrete structures for the Diesel project. The lagging and reinforcement design was done almost completely with 3D modeling," describes Team Manager **Matti Ahonen**.

He says designing steel and concrete structures in the same model clearly improved the quality of building:

"It has now been easier to check the boundary surfaces. That said, for us more knowledge has also been a source of anguish – conflicts and other problems that used to be solved later down the line onsite were identified already in the design stage. You have to give credit to Neste Oil for understanding the advantages of 3D design for the project as a whole."



WORK CONTINUES IN THE BIODIESEL PROJECT

> The experience gained in the Diesel project is already being utilized in Neste Oil's Biodiesel project launched in the beginning of 2005. The 100 million euro biodiesel plant will start operations in summer 2007.

"Almost all of the design parties in the Diesel project are participating in the Biodiesel project. The structural design system has been updated from Tekla Structures version 10 to 11. We've started out using the Diesel project's doctrines with the aim of making improvements where room for improvement is found. Designing concrete structures is bound to become more efficient as more and more stakeholders join the development of the concrete module. We also aim to make advances with secondary supports by further enhancing co-operation between plant design and structural design," says Markku Eerikäinen Manager, Information Management from Neste Jacobs.

"Continuing along the same path demonstrates that the Diesel project has been a success. I'm sure that for all involved, Diesel was a venture of which we can be justly proud. During their careers, few people will have an opportunity to work on more than a handful of projects of this class."

CONTACT:

Tekla Corporation (HQ)

Metsänpojankuja 1

P.O. Box 1

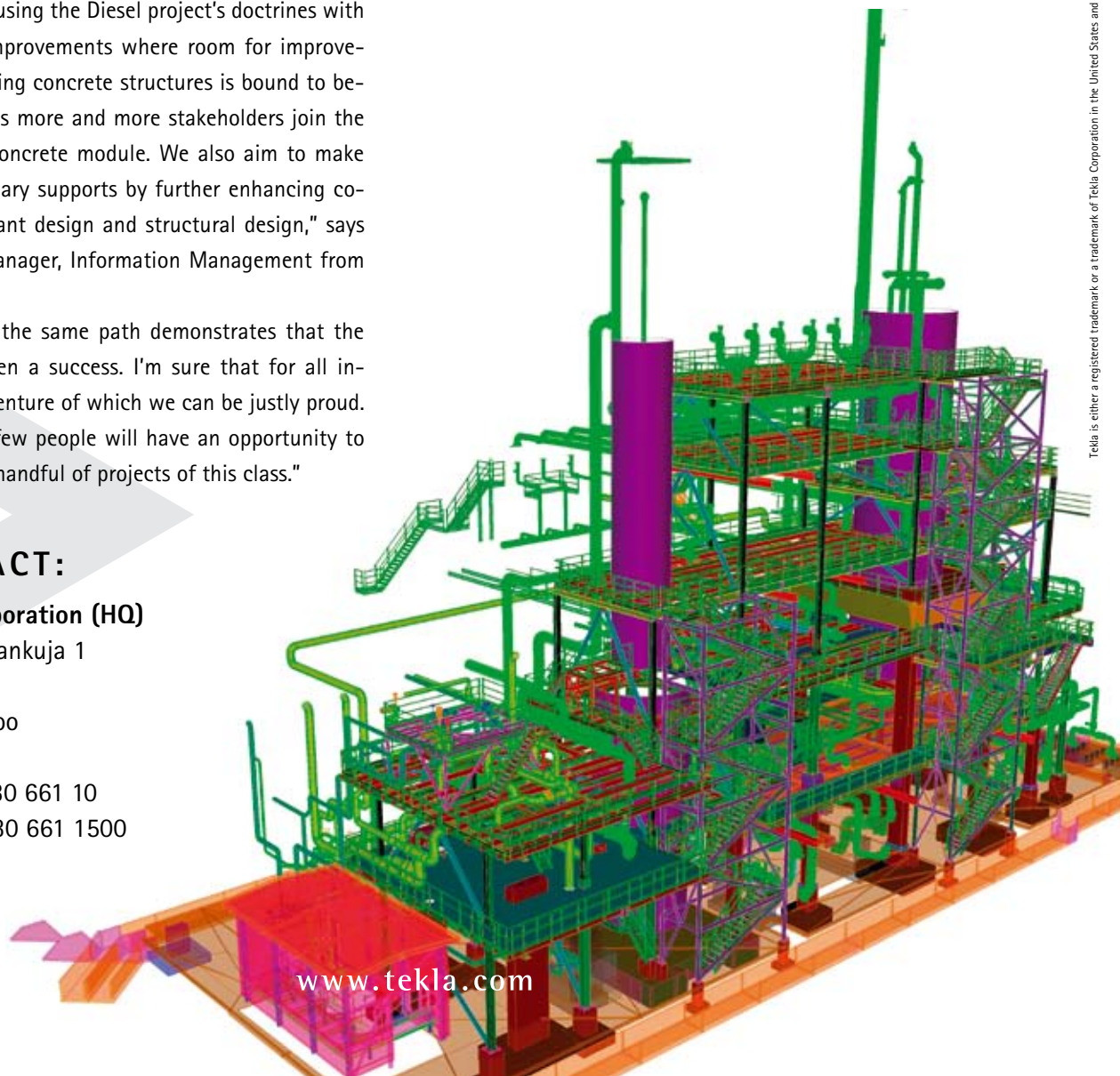
02131 Espoo

FINLAND

Tel. +358 30 661 10

Fax +358 30 661 1500

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