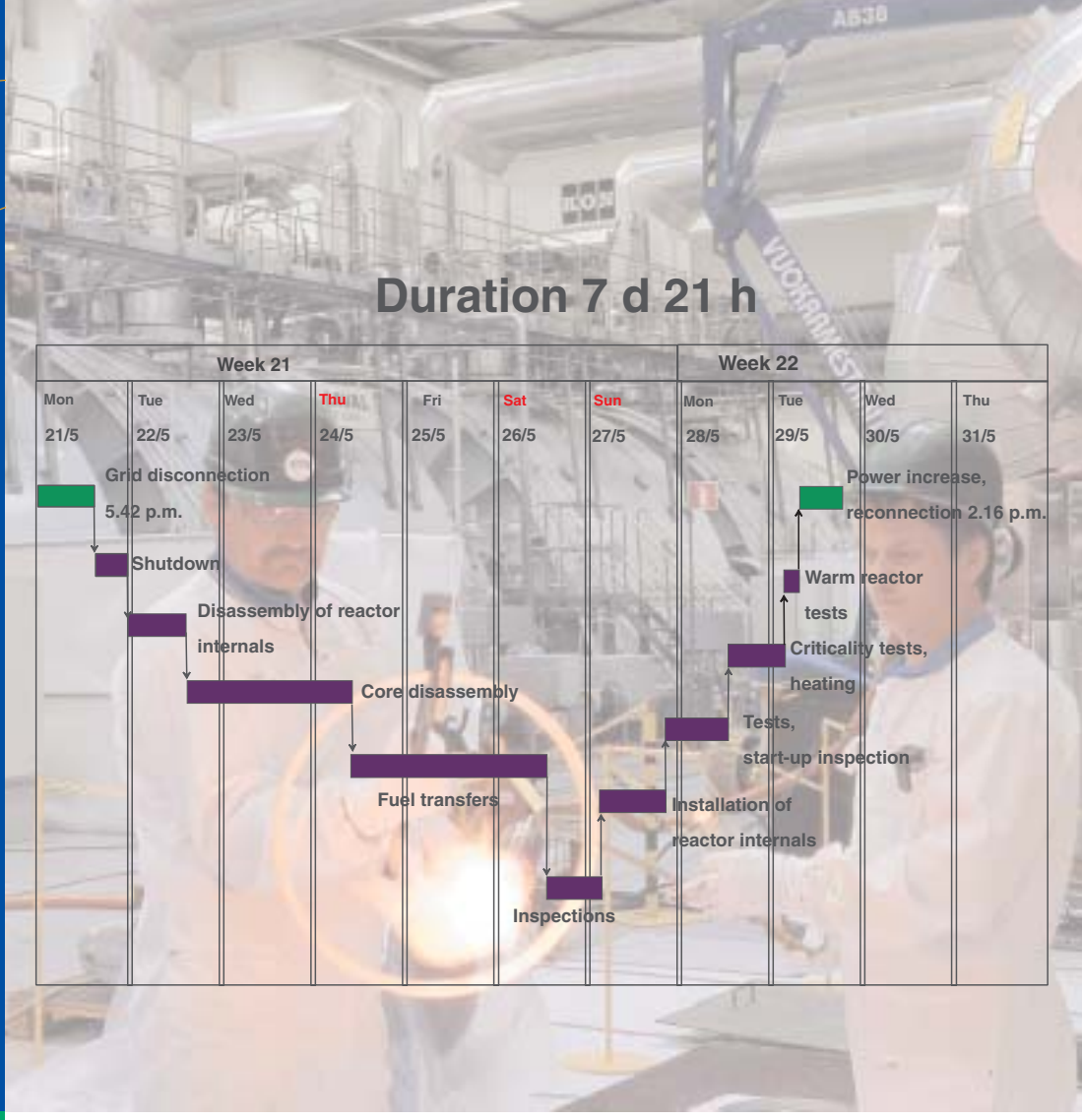


# Outage Excellence
## Olkiluoto NPP 2001

TVO

Teollisuuden Voima Oy

*TVO Nuclear Services Ltd. (TVONS), a subsidiary of Teollisuuden Voima Oy, markets the knowledge of TVO employees. Outage planning and implementation is one of the key areas. During this year's outage, TVONS arranged a training period on short and middle term outage planning for the employees of the Kola NPP in Russia. The training was related to the European Union Tacis agreement. Four motivated and good-humoured trainees toured the plant area with their hosts, receiving practical knowledge as well as lectures.*

*TVONS has been part of the Tacis programme since February 2000. The programme aims at developing the nuclear power plants in Russia and its neighbouring areas.*

TVO NUCLEAR SERVICES

*Contact information on back cover.*

Photos: Markku Korpi-Hallila

Layout: Sataviestintä Ky

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The print paper has received a Nordic environmental award.

## Contents

## *Professional co-operation*

The availability of nuclear power plant units during their operational cycle is determined by the quality and correct priority of work carried out during outages. Both of the Olkiluoto units have had top-class availability factors during their entire operational history. The high level of expertise and long-term co-operation of both the TVO staff and contractor employees are key factors in achieving this success.

Both Olkiluoto units underwent refuelling outages in 1999 after the successful completion of the modernisation project. In the year 2000, service outages were carried out on both plant units. Starting this year, a new outage programme is introduced, consisting of service and refuelling outages every other year on each plant unit. This year, the service outage was carried out on unit 2, while on Olkiluoto 1 work was limited to the scope of a refuelling outage. The completion of the Olkiluoto 1 outage in under 8 days is an excellent achievement, and goes to show that the principles of refuelling outages are mastered with increasing accuracy.

The modernisation of electrical and I&C systems is the single most important project in the first outages of the millennium. This year, a number of modifications were carried out on Olkiluoto 2, and the same trend will continue each year on the unit undergoing a service outage.

A professional approach to work was characteristic of all the outage workers at Olkiluoto this year. The increasing openness in the reporting of "near miss" incidents is a very favourable development, which will help us improve our activities further in the future.

Mauri Hakola
Outage Manager

# Outage and Maintenance Strategy

The Olkiluoto NPP outage strategy consists of two main outage types: refuelling and service outages, with 12-month operating cycles in between. When needed, extra-long service outages may also be carried out. The strategy is mainly based on the demands of the electricity market and the needs of equipment maintenance.

The open electricity market imposes new demands on nuclear power companies. The production of electricity must be as cost-efficient as possible, while operating within or above required safety margins. At the same time, an uninterrupted supply of electricity must be available whenever required. This calls for the optimisation of maintenance measures as well as outage durations. At Olkiluoto, a system of preventive maintenance optimisation has been adapted to ensure that work resources are correctly allocated and an optimal amount of maintenance is carried out.

Due to the climate in Finland, a 12-month operating cycle is the most beneficial. May and June, in turn, are the best outage times - largely due to the availability of hydroelectric power. Outages at Olkiluoto are invariably scheduled to begin in early May.

## Refuelling and service outages

Two types of outages follow each other in sequence at the Olkiluoto plant units. A refuelling outage consists of refuelling the reactor and carrying out all necessary repairs, annual tests and inspections, as well as service and preventive maintenance scheduled for one-year intervals. The typical length of a refuelling outage is about 8 days. A service outage, with an average length of 14 days, includes all the work tasks of a refuelling outage together with system overhauls and plant modifications or improvements.

During a longer time period, an extra-long service outage may be carried out. Such an outage includes major plant modifications with significant workload requirements. The next extra-long outages are scheduled for 2005 (Olkiluoto 2) and 2006 (Olkiluoto 1).

# Technical condition of plant units

The modernisation project carried out during 1994 – 1998 has proved successful, and both Olkiluoto plant units have continued operation with excellent results. The most important challenges in the future will deal with the continued modernisation and optimisation of the turbine plant, and especially the modernisation of electrical and I&C systems.

## Reactor plant

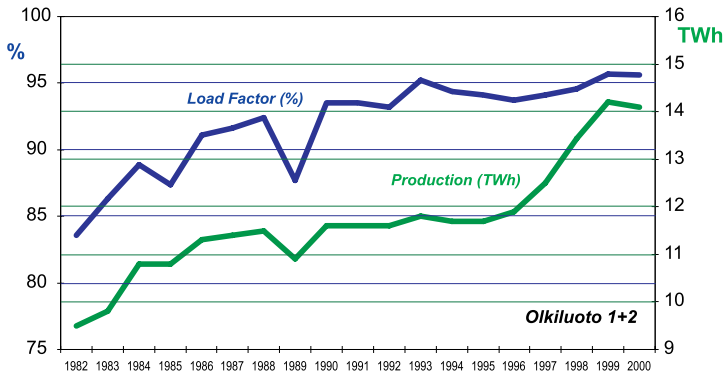
There are no major problems at the reactor plant. The moisture level of steam (ca. 0.3%) after the power up rating and exchange of the steam separator is not fully satisfactory, and will probably require further counter-measures. The forthcoming major improvements on other parts of the reactor plant will mostly consist of renovations in certain isolation valves.

## Turbine plant

The turbine plant is in fairly good condition. Further improvements are planned to meet known aging problems and to optimise the turbine pre-heater process. These include, among other things, the exchange of re-heaters and perhaps the HP turbine (evaluations in progress), as well as modifications in the condensate and feed water systems. The seawater cooling systems will also require upgrading in the future.

## Electrical equipment and instrumentation

Due to both the power up rating and the aging of technology, the electrical and I&C equipment has undergone major renovations. These have included, for example, the main transformers, electrical systems of the recirculation pumps, the reactor power measurement system and the protection and control system of the turbine. The electrical devices and containment cabling, among others, are in good shape. The most important challenges in the future will be presented in the field of automation, where new digital systems are replacing older analogue controls. The installation of these systems has started at the turbine plant and other systems with less safety significance. After enough experience has been gathered, they will be introduced into the more safety-related reactor systems.




*Annual Production and Load Factors.*

# Operational cycle overview

High load factors have become a tradition at Olkiluoto: for the past 10 years, the average load factors have been over 94 per cent. The load factors for operational cycle 2000 – 2001 are, once again, among the absolute highest in the world.

## Olkiluoto 1 operation

The plant unit was restarted on June 7th, 2000 after the outage. At Midsummer, June 22nd – 27th, the unit operated at decreased power due to low electricity demand. In July 2000, the frequency converter automation on one of the recirculation pumps failed several times, causing one of the six pumps to fall to minimum rotation. This lowered the power level of the unit to 93%. A periodic test performed on October 15th indicated a fault in one of the feed water system isolation valves. The valve was repaired after the test. All other production losses resulted from periodic tests. The unit started coast-down on April 29th, 2001 and the refuelling outage was started on May 21st.

Reactor work was completed on the evening of May 27th, 2001. The reactor safety system tests were ready by the afternoon of May 28th, and start-up permission was received at 5.30 p.m. on the same day. On May 29th at 2.16 p.m., after only 21 hours, the unit was connected to the national grid. Olkiluoto 1 reached full power on May 31st at 11.34 a.m.

## Olkiluoto 2 operation

The outage for the year 2000 ended on May 23rd, 2000 when the unit was restarted. Due to decreased power demand, the unit ran at a low power level between June 22nd – 26th. In July, one of the feed water pumps stopped due to an erroneous high bearing temperature reading, causing the power level to temporarily fall to 90%. There were no disturbances during the rest of the year 2000 and early spring 2001.

Not taking into account the production breaks caused by annual outages, Olkiluoto 2 supplied electricity to the national grid for 978 days with no interruptions. This disturbance-free period ended on March 21st, 2001, when a drain tank level measurement transducer failed in the pre-heating system, causing a reactor scram. Coast-down started on April 21st, 2001, and the service outage began on May 6th.

Refuelling was completed on May 15th, 2001 at 1.35 a.m., after which the reactor safety system tests were started. The start-up permission was received on May 19th at 12.00 pm. The unit was reconnected to the national grid on May 21st 9.37 a.m. and it reached full power on May 23rd at 1.00 p.m.

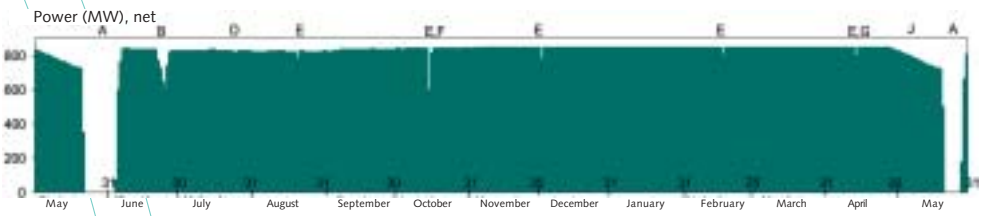
## Production

The load factors for the operational cycle were 99.5% for Olkiluoto 1 and 99.0% for Olkiluoto 2. These figures also include the power reductions at Midsummer. Energy availability was 99.7% for unit 1 and 99.2% for unit 2; both are excellent figures. The joint total production exceeded 244 TWh by the start of the outage. Production results during the operational period were very satisfactory.

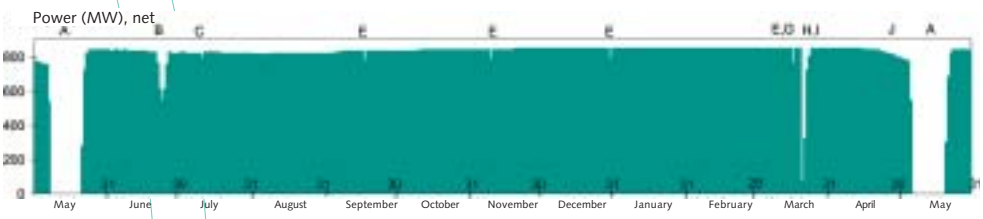
## Production data 2000

| | OL1 | OL2 |
|---|---|---|
| *Operational cycle* | *4/6/2000 – 21/5/2001* | *21/5/2000 - 6/5/2001* |
| *Gross electrical energy, GWh* | *7 291* | *7 238* |
| *Net electrical energy, GWh* | *7 023* | *6 974* |
| *Production losses, due to:* | | |
| *- Equipment failure, GWh* | *5 (0.1 %)* | *36 (0.5 %)* |
| *- Power demand, GWh* | *15 (0.2 %)* | *20 (0.3 %)* |
| *- Sea water temperature, GWh* | *50 (0.7 %)* | *58 (0.8 %)* |
| *Reactor critical, h* | *8 439* | *8 425* |
| *Generator connected, h* | *8 422* | *8 375* |
| *Energy availability, %* | *99.7* | *99.2* |

## Olkiluoto1 operation 4/6/2000 - 21/5/2001




## Olkiluoto 2 operation 21/5/2000 - 6/5/2001




*A=Annual outage, B=low electricity demand, C=feed water pump repair, D=recirculation pump malfunction, E=periodical test, F=inspection of missing feed water system valve indication, G=alteration of control rod sequence, H=reactor scram due to instrument fault in feed water pre-heating system, I=re-heater control valve repair and J=Coast-down.*

# Outage overview 2001

Starting this year, a new outage programme has been implemented at the Olkiluoto plant units. Each year, one unit undergoes a longer service outage, while a short refuelling outage is carried out on the other. The different outage types follow each other in sequence.

On Olkiluoto 2, the most important work tasks of the service outage were renovations of the electrical and I&C systems, pipe renovations at the reactor plant, the containment leak rate test, renovation of three feed water pumps and work at the sea water channels. The outage for unit 2 began on May 6th, 2001 and ended 14 days and 15 hours later, on May 21st.

On the same day of the start-up of Olkiluoto 2, outage work started on unit 1. The outage only lasted for 7 days and 20 hours, setting the new record for Olkiluoto outages. During this time, the reactor was refuelled, a 380-volt UPS system was renovated, the lower containment airlock was strengthened and other scheduled services and inspections were carried out.

## Emphasis on I&C system renovations

The original plant automation at the Olkiluoto units is based on analogue equipment. However, during the past few years, electrical and I&C equipment has experienced rapid development owing to advances in the field of programmable automation. New options have also become available for nuclear power plant operation.

The most important project this year was the renovation of the control rod manoeuvring system at Olkiluoto 2. Next year, the same work will be carried out on Olkiluoto 1 during the service outage. The project originated from the high age and spare part unavailability of the original Norsk-Data-based equipment. The computer and its process interface, scram test unit and auxiliary control panel were replaced by the Siemens Simatic S7 system from Framatome ANP GmbH. Related components at the switch bay were also renovated. The new manoeuvring system allows for more testing and data collection to be carried out automatically. Over 80 workers took part in the project, working in two shifts.

Competent personnel resources are the key to successful outages. In addition to TVO staff, a total of 900 contractor employees took part in outage work this year. Work carried out during the outage amounted to 126 person work-years, and the realised outage costs were ca. € 13 million.

## Outages 2001

| Olkiluoto 2 | Olkiluoto 1 |
|---|---|
| 14 days 15 hours 32 minutes<br><br>• Service outage<br>• Planned length exceeded by 1 day 10 h due to additional work on the reactor path and control rod manoeuvring system tests<br><br>Significant work tasks:<br>• Refuelling (130 assemblies)<br>• Valve service: 245 containment valves tested, 8 serviced, 220 valves serviced at reactor and turbine plants<br>• Recirculation pump service (3 pcs)<br>• Feed water and coolant pump service<br>• Piping renovations at the reactor plant<br>• Modernisation of 3 feed water pumps<br>• Sea water channel maintenance<br>• Containment leak rate test<br>• Electrical and I&C system renovations:<br>  • Control rod manoeuvring system<br>  • 380-volt UPS equipment in 2 out of 4 subsystems<br>  • Fire detection system<br>  • Data collection system<br>  • Disturbance monitoring computer<br>  • Camera surveillance system | 7 days 20 hours 34 minutes<br><br>• Refuelling outage<br>• Planned length undercut by 3 hours 26 minutes<br><br>Significant work tasks:<br>• Refuelling (134 assemblies)<br>• Valve service: 226 containment valves tested, 102 valves serviced at reactor and turbine plants<br>• Feed water pump service<br>• Lower containment airlock renovation<br>• 380-volt UPS equipment modernisation in one subsystem |

# Maintenance and modifications

## Reactor

The reactor disassembly and assembly work required by the refuelling was carried out on both plant units.

On Olkiluoto 1, work was carried out according to the limited scope of a refuelling outage. As an additional work task, the motors of two recirculation pumps were replaced.

Olkiluoto 2, in turn, had its second consecutive service outage. In conjunction with the piping renovations in the RPV lid cooling system, the insticks tubes were removed and plugs were installed in the nozzles. A total of 14 control rod drives were serviced. During service, the drives were found to be in very good condition. As preventive maintenance, the motor and impeller of one recirculation pump were replaced. Two recirculation pump motors were also replaced due to low insulation resistance.

A maximum of 42 contractor employees took part in reactor work during the outage.

## Turbine

Turbine bearings 3 and 4 and generator bearings 6 and 7 were inspected at the Olkiluoto 2 turbine plant. The bearings were in good condition. One high-pressure turbine valve and both re-heater valves were serviced, and two low-pressure turbine valves with their actuators were replaced.

An extensive amount of pumps and adjustment valves were serviced in the bearing oil and control oil systems. Pumps, filters and valves in the turbine condenser clean-up system also underwent service.

On Olkiluoto 1, the most significant work task was the replacement of one oil pump. The intake pipes of all three oil pumps were replaced with larger ones. Generator bearings 6 and 7 were inspected.

## Electrical and I & C systems

Service and testing was carried out on both plant units according to the annual maintenance schedules. Modifications were carried out to resume the modernisation of electrical systems. Both plant units had 11 new static protective relays installed. UPS equipment was installed to replace 2 rotating converters on Olkiluoto 2 and one converter on Olkiluoto 1.

The modernisation of feed water pump motors was resumed by replacing 2 motors on Olkiluoto 2. The new motors were modified to operate at a higher power level. The control rod manoeuvring system was also modernised, a new camera surveillance system was installed and the new measurement computer was commissioned. Fire detection system installation and commissioning continued on both plant units.

A total of 247 contractor employees participated in outage work on the electrical and I & C sector.

## *International co-operation*

A project group from Framatome ANP GmbH, a joint company formed by Siemens KWU-N and Framatome, was at Olkiluoto to execute the CRIMS project (Control rod manoeuvring system modernisation). We interviewed project manager **Manfred Beismann** after the work was successfully done.

**Have you worked in Finland before?**

This was my first assignment in Finland, but I have plenty of international work experience. Since starting work at Siemens/KWU - on a nuclear power plant project similar to OL1 & 2 - in 1975, I have worked on a conventional power plant simulator project in India, a nuclear power plant simulator in the USA and on several smaller I&C projects, in Sweden for example.

**When was planning started on the CRIMS project?**

The project first started with preparing the offer in the middle of 1999 and by January 2000 we were contracted. It was clear from the very beginning that if we got this assignment I would be the project manager. I spent three months in Finland in the spring of 2000 with 5 of my colleagues to gather information necessary for the project. Apart from the weather, I had very positive experiences back then!

**How was your co-operation with the Finnish project group and technicians?**

Excellent; it was a pleasure to work with people who have a clear idea of the task at hand. We also had many opportunities to learn from each other. For example, many of the software people in our group were not familiar with the strict regulations concerning nuclear power plants, while our Finnish counterparts were more "free" in terms of non-safety related issues.

**Was there anything notably easy or difficult about the planning of the modifications?**

The excellent plant documentation, complete with all signal routes and interfaces, made our work substantially easier. On the other hand, the original design documents supplied by the plant vendor were not available or not suitable for planning larger modifications.

**How did the project succeed, in your opinion?**

Extremely well, which I feel was largely due to the excellent co-operation. The people at Olkiluoto have a really positive culture of taking personal responsibility and making quick decisions, and this allowed for the installation to be carried out during such a limited time. This must also be one of the key factors contributing to your short outages.

## Valves, pumps, heat exchangers and pressure vessels

Leak rate tests were performed on 226 containment isolation valves on Olkiluoto 1 and 245 valves on Olkiluoto 2. All valves on unit 1 passed the test, but 8 valves were serviced on Olkiluoto 2 due to the test results. The containment of Olkiluoto 2 was also tested for leak rate with satisfactory results. A significant amount of pump service took place on both plant units.

Scheduled pressure vessel inspections were carried out on 14 registered pressure vessels on Olkiluoto 1 and 48 vessels on Olkiluoto 2. Based on inspections, a total of 48 and 42 demisters were replaced in the re-heaters of Olkiluoto 1 and 2 respectively. All the seawater, room and motor coolers were washed and inspected.

Additional work amounted to about 8 % of the total work done during the outage. The most significant work tasks were the replacement of the auxiliary feed water pump motor on Olkiluoto 1 and the back-up diesel generator replacement on Olkiluoto 2. A maximum of 250 contractor employees took part in mechanical equipment service together with in-house personnel.

## Modifications

A total of 94 plant modifications were carried out on Olkiluoto 2. For Olkiluoto 1, the amount was 46. In all, 45,000 man-hours were spent on modifications. The largest modifications on Olkiluoto 2 were the piping and valve renovations in the reactor vessel lid cooling system, and the feed water pump and hydraulic coupling modifications allowing the unit to operate with three feed water pumps. Cathode protection was installed in the concrete of seawater channels S2 and S4. The modernisation of the control rod manoeuvring system was the most significant I&C modification, while on the electrical side, the replacement of rotating converters took up the most resources. Fire alarm system renovations were also resumed.

On Olkiluoto 1, significant modifications included the renovation of the lower containment airlock, fire alarm system modernisation, installing cathode protection in seawater channel S1 and replacing one rotating converter with UPS equipment.

## Building maintenance

The most important work tasks of building maintenance included scaffolding, lifting and painting as well as modifications, hauling and diving work. Door service and inspections were also carried out. Scaffolding work required the most resources, and contractors were largely used.

The exhaust side seawater channels are dried and inspected at 8-year intervals. This year, the seawater channels of Olkiluoto 2 were serviced, and cathode protection was installed in the concrete steel linings. The concrete required less service than predicted, and the installed protection is expected to reduce the need even further.

In addition to in-house staff, 65 contractor employees took part in outage work in the building maintenance area.

# Fuel work

## Olkiluoto 1

A total of 584 fuel transfers were carried out on Olkiluoto 1. The core was refuelled with 136 fresh assemblies of type ATRIUM-10B, manufactured by Framatome ANP. Two fuel elements were inspected, and no significant findings were made. For the first time, fuel transfers were optimised by eliminating unnecessary refuelling machine movement. When spent fuel was moved to the fuel pools, fresh fuel was brought into the reactor on the return trip. This new procedure saved approximately 11 hours, reducing the total fuel transfer time to 71 hours. No anomalies were discovered in the final core inspection.

## Olkiluoto 2

On Olkiluoto 2, 651 fuel transfers were made and 132 fresh fuel assemblies were installed into the reactor. The new fuel was of type GE12, manufactured by GENUSA. Six fuel elements underwent fuel and channel inspections. The core inspection showed no anomalies. Fuel transfers required a total of 93 hours.

# Protection

## Radiation protection

The total accumulated radiation doses were 266.7 mmanSv for Olkiluoto 1 and 721.7 mmanSv for Olkiluoto 2. The total doses were somewhat lower than expected. The most demanding work tasks in terms of radiation protection were the piping modifications of the shutdown cooling system and RPV lid spray system on Olkiluoto 2. The total work dose was 142 mmanSv, 20 mmanSv less than anticipated. A significant part of the accumulated dose was received from isolation work, inspections, cleaning and valve service. A total of 1389 persons were under dose surveillance on Olkiluoto 1; for Olkiluoto 2, the number was 1625.

## Fire protection

In all, 340 separate fire protection instructions were prepared, while last year the number was 460. The piping modifications at Olkiluoto 2 were the most demanding work tasks as regards fire protection.

The fire department responded to 14 alarms during the outages, while there were only 4 alarms in the year 2000. The most part of the alarms were caused by the new fire detection system, whose sensors are significantly more sensitive than the previous models. A total of 3 smaller fires were reported (caused by electric devices and rags). There were two first response alarms, but no elevator alarms, which have been frequent during previous outages.

## Industrial safety

This year, industrial safety was chosen as the theme of the outages. The goal was to complete the outages with zero accidents, and personnel were encouraged to report "near misses". The standard of industrial safety remained high throughout the outages, and no serious work accidents occurred. Ten minor accidents were reported, 4 of these leading to work absence. A total of 35 near misses were reported. Industrial safety inspection rounds were carried out once a week during both outages.

## Waste management and decontamination

Waste accumulated during the outage amounted to 15 tonnes of radioactive service waste and 8 tonnes of metal waste. The portion of Olkiluoto 1, undergoing a refuelling outage, was 5 tonnes of service waste and 1 tonne of metal waste – a very low amount paralleled only by the outages in 1999. The major decontamination tasks were related to valve and pump service and tool cleaning.

## Chemistry

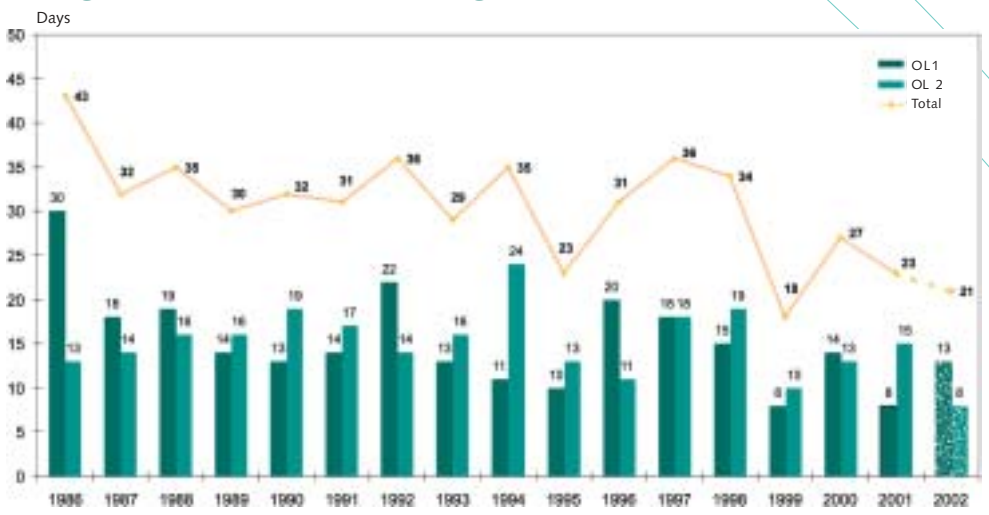
Both outages succeeded well from the chemistry point of view. The amount of activated corrosion products in the reactor water during shutdown was very low on both plant units. The MADAC activity measurements performed at OL2 showed decreased activity levels in most systems.

New ECP and conductivity measurement devices were installed on Olkiluoto 1 in the previous outage. The electrodes in these devices were replaced this year. Material samples in the primary circuit were measured and partially replaced.

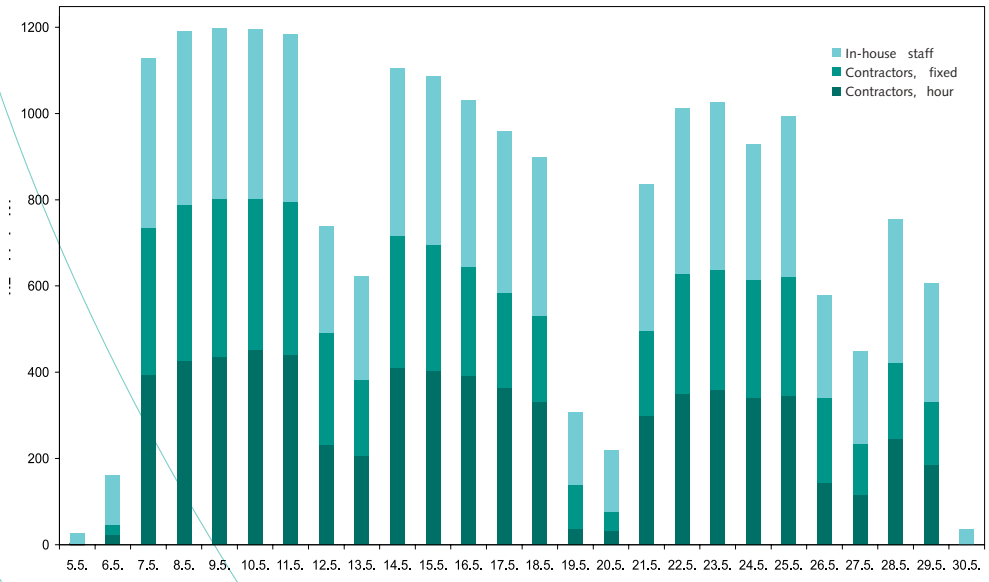
Environmental emissions during the outages were low.

# Outage data 2001

## Lengths of annual outages




## Outage personnel




## Person work-hours

Person work-hours / 1000 h divided as follows (equivalent of 126 person work-years):

| | OL1 | OL2 | TOTAL |
|---|---|---|---|
| Contractors | 44 | 88 | **132** |
| In-house staff | 27 | 49 | **76** |
| **Total** | **71** | **137** | **208** |

## *Housing and leisure time*

About 6,400 occupancies were recorded at the Olkiluoto housing village, Munakari cottages and the trailer park. On the peak day, May 10th, there were 383 lodgers.

Several activities were arranged for outage personnel. These included making pancakes and fried fish, having singsongs and taking part in a fitness test. The housing village facilities, including pool tables, Internet terminals and a grillroom, were also available.

Outage personnel were encouraged to point out areas of improvement through the improvement proposal programme. A total of 25 replies were received.

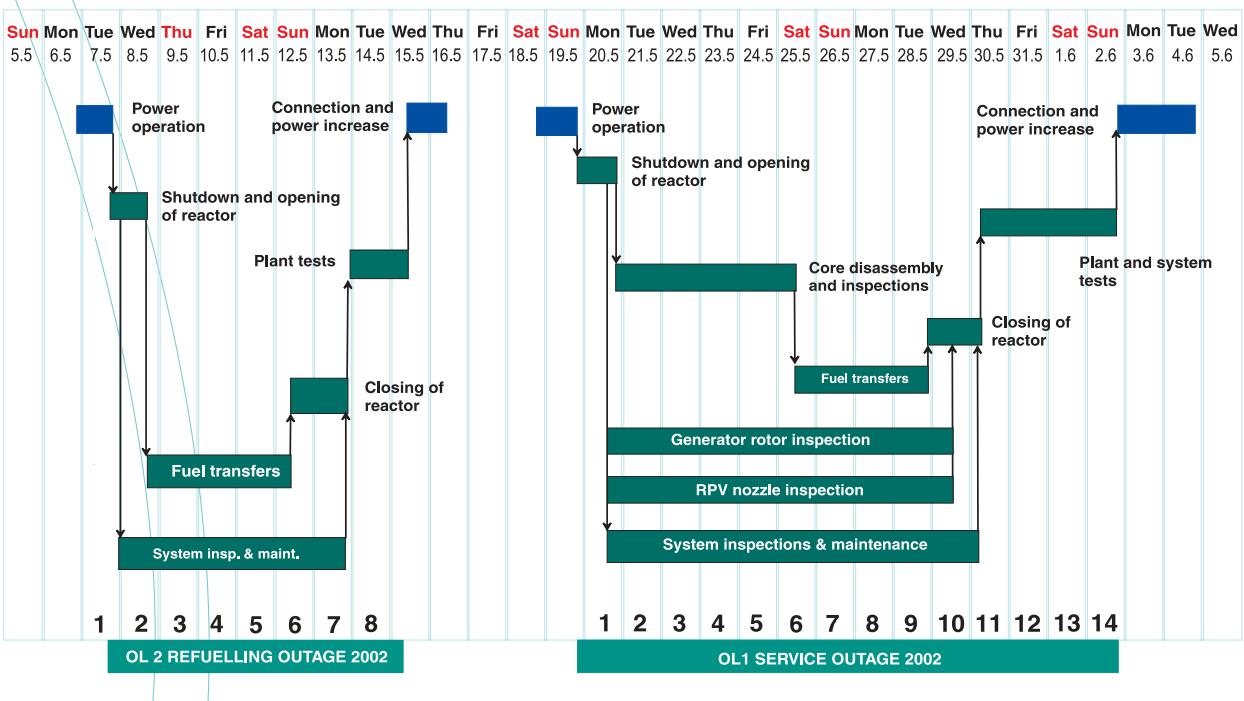
## Main contractors 2001

ABB Alstom Power
ABB Alstom Power Finland Oy
ABB Industry Oy
ABB Installaatiot Oy
ABB Kiinteistöpalvelut Oy
ABB Service Oy
AEG SVS Power Supply
Affecto Oy
Ahlberg Electronics Ab
AIR-IX Suunnittelu Oy
Alaratech Oy
Alstom
Alstom Anlagen und Antriebssystem
Alstom Power Generation Ab
Alstom Power Sweden Ab
Armatek Oy
Arme Oy
Asennus N & H Service Oy
Bopp & Reuther
CCI Ag
CLS-Engineering Oy
Dosesoft Oy
Eurajoen Paloteam Oy
FORCE Institute
Fortum Power and Heat Oy
Fortum Service Oy
Framatome ANP GmbH
GE ENUSA Nuclear Fuels, S.A.
Hayward Tyler Engineered Product
Hayward Tyler Services Ltd
Humittest Oy
Hämeen Lämpöeriste Oy
ICL Invia Oyj
I&E Systems Oy
Ilmastointi Salminen Oy
Insinööritoimisto Paintco Ky
Inspecta Oy
Instrumentointi Oy
Isenta-Willich Oy
Jamtec Oy
JP-Suunnittelu Oy
JS Oy Pietarsaari
Karhu-Kopio Oy
Kone Oy
Koneistus J. Lähteenmäki
KPA-Teollisuusputkistot Oy
Kriko Engineering Gmbh
Kuljetusneliö Oy
Kumijaloste Oy
Lämpösulku Oy
Lännen Puhelin Oy
Maalausliike Reijo Heino Ky
Masino Oy
M-Cinema Ky
Metso Works Oy
Mekeltek Oy
NDT-Tekniikka Oy
Noorfin Oy
Notrik Oy
Nostopalvelu Haapanen Oy
Oy Esmi Ab
Oy Huber Testing Ab
Oy Mercantile-KSB Ab
Oy Transbaltic Ab
Pikoteknik Oy
PI-Rauma Oy
Pointo Nokia Oy
Polartest Oy
Power-OM Oy
Powerware Oy
Prosessiputkitus Oy
Rakennushuolto Kallio & Forss
Rakennusliike Rauvola & Simula Oy
Rauman Kansanterveystyön Kuntayhtymä-
Rauman Metallipaja Oy
Rauman Monitori Oy
Rauman Offsetpaino Oy
Rauman RS-Rakennus Oy
Rauman Sähköpalvelu Oy
Rauman Tekniikkakeskus Oy
Rauman Viemäripalvelu Oy
Raumanmeri Oy
Roster-Tekniikka Oy
RTK-Palvelu Oy
Sammet-Asennus Oy
Savcor ART Oy
Securitas Oy
Sempell Armaturen Service Gmbh
Siemens Aktiengesellschaft
Siemens Oy
Siemens Oy/Automaatiohuolto
Simelectro
Sodexho Oy
Steka Oy
Suomen Merisukellus Oy
Suomen Voimatekniika Oy
SVS Supervise Service Oy
Sähkö-Rauma Oy
Sähkötarkastuskeskus Fimtekno Oy
Säkylän Sähkö-Puisto Oy
Säkkiväline Pesupalvelu
Säteilyturvakeskus (STUK)
Taprogge Gesellschaft mbh
TAP-Service Oy
Telinekataja Oy
Tietoenator Oyj
Timanttityö Santala Oy
Turun Prosessiasennus Oy
U & J Helin Oy
Valtion teknillinen tutkimuskeskus
Varsinais-Suomen Putkisto-TV
Vesi-Vasa Oy
VTT Automaatio
VTT Energia
VTT Rakennustekniikka
VTT Valmistustekniikka
Westinghouse Atom Ab
Westinghouse Atom TRC Ab
Weisz' Mekkonst Aktiebolag
Xerox Oy
YIT Power Oy
YIT Power Oy Voimalaitososasto
YIT Power Oy Ylivieska
YIT Service Oy

## Goals

| | | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Realised | Realised | Realised | Realised | Realised | Realised | Realised | Realised/Goal | Goal |
| Operational cycle availability factors | OL1 | 99.7 | 98.5 | 99.4 | 97.3 | 99.1 | 99.5 | 99.1 | 99.6/99.5 | 99.5 |
| | OL2 | 98.8 | 97.4 | 97.2 | 98.2 | 98.9 | 99.0 | 99.0 | 99.0/99.5 | 99.5 |
| Costs (million €) | | 14.97 | 10.43 | 19.01 | 22.03 | 26.57 | 9.1 | 17.5 | 13.0/12 | 12 |
| Contractor employees (max/persons) | Weekdays | 980 | 740 | 1200 | 1140 | 1236 | 671 | 870 | 800/800 | 800 |
| | Weekends | 440 | 340 | 400 | 617 | 723 | 134 | 356 | 490/200 | 200 |
| Outage length (days) | OL1 | 12 | 10 | 20 | 18 | 15 | 8.5 | 14 | 8/8 | 13 |
| | OL2 | 24 | 13 | 11 | 18 | 19 | 10 | 14 | 15/13 | 8 |
| Radiation doses (manSv) | | 2.2 | 0.9 | 1.4 | 1.5 | 1.8 | 0.71 | 1.5 | 1.0/1.0 | 0.8 |
| Plant start-up from permission to grid connection (h) | OL1 | 23 | 29 | 51 | 44 | 15 | 22 | 23 | 21/24 | 24 |
| | OL2 | 62 | 31 | 43 | 45 | 18 | 27 | 63 | 33/24 | 24 |
| Responsible and open work community | | | | | | | | | | |

## Schedule



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