2005

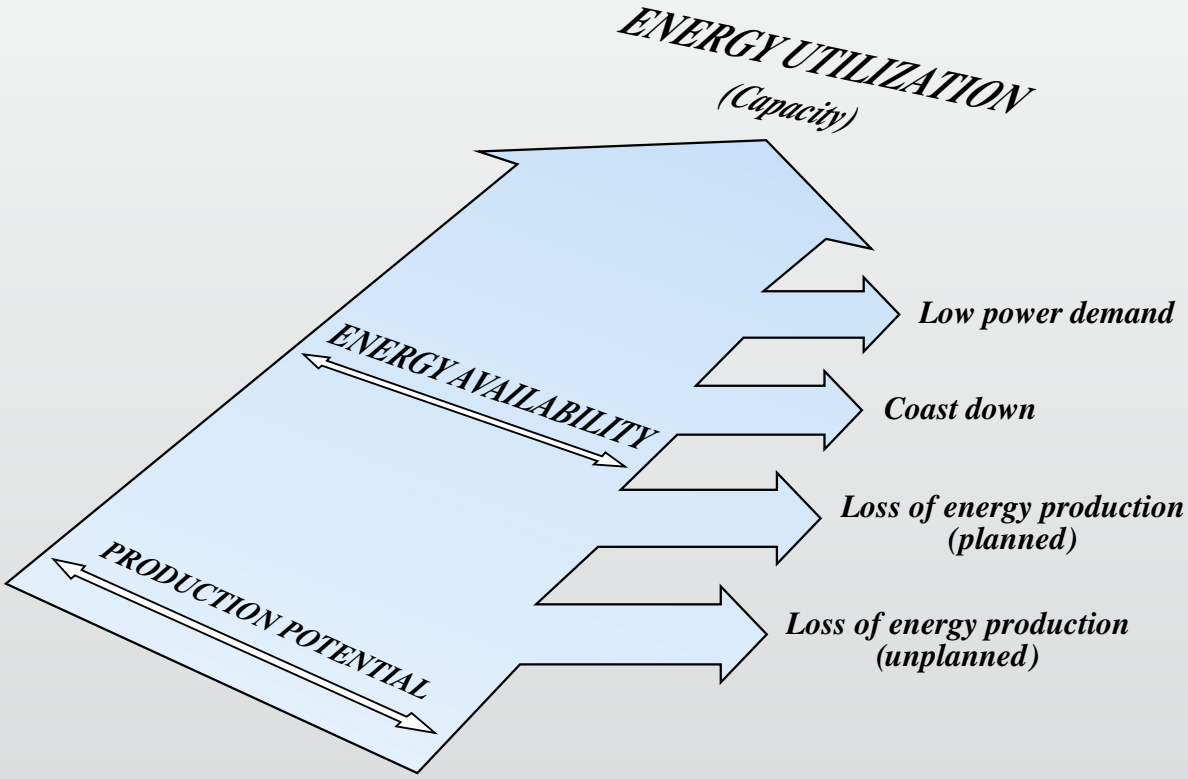
Summary of

Operating Experience

in Swiss Nuclear Power Plants

2004

swissnuclear
Nuclear Energy Section of swisselectric



SWISS NUCLEAR POWER PLANTS

Power station	Type of reactor	Net output (MWe)	Commercial operation
Beznau (KKB)	PWR	365	Unit 1: Dec. 24, 1969
		365	Unit 2: March 15, 1972
Mühleberg (KKM)	BWR	355	November 6, 1972
Gösgen (KKG)	PWR	970	November 19, 1979
Leibstadt (KKL)	BWR	1165	December 15, 1984

DEFINITIONS

(Corresponding to the UNIPEDE classification «Statistical Terminology Employed in the Electrical Supply Industry»)

Energy availability factor – Etg/En
(UNIPEDE definition 4.6.03.f)
Energy utilization factor – Ed/En
(UNIPEDE definition 4.5.01)

En *(Production Potential)*
– energy producible assuming maximum capacity continuously available throughout a specific period

Ed *(Energy Utilization)*
– energy actually produced within a specific period

Etg *(Energy Availability)*
– energy producible assuming available capacity during a specific period

Switzerland's five nuclear power reactor units continued their strong contribution to the national electricity supply in 2004. The nuclear share of overall electricity production in Switzerland was 40%. Net production of the nuclear park was 25.43 TWh – a decrease of 2% compared with 25.9 TWh in 2003.

Worldwide consumption of energy is still growing and energy prices are rising. From this perspective nuclear power's importance for a secure, efficient and reliable power supply is evident and increasing. Decisions in several countries like China, Finland and France, to build new nuclear power plants have to be seen against this background and are reflecting a «renaissance» of nuclear power. The newly launched discussion over the replacement of Switzerland's existing nuclear power plants by new ones must also been seen in this context. Producing electricity with nuclear technology has obvious technical, economic and ecological advantages. Politicians and the public are increasingly recognising this.

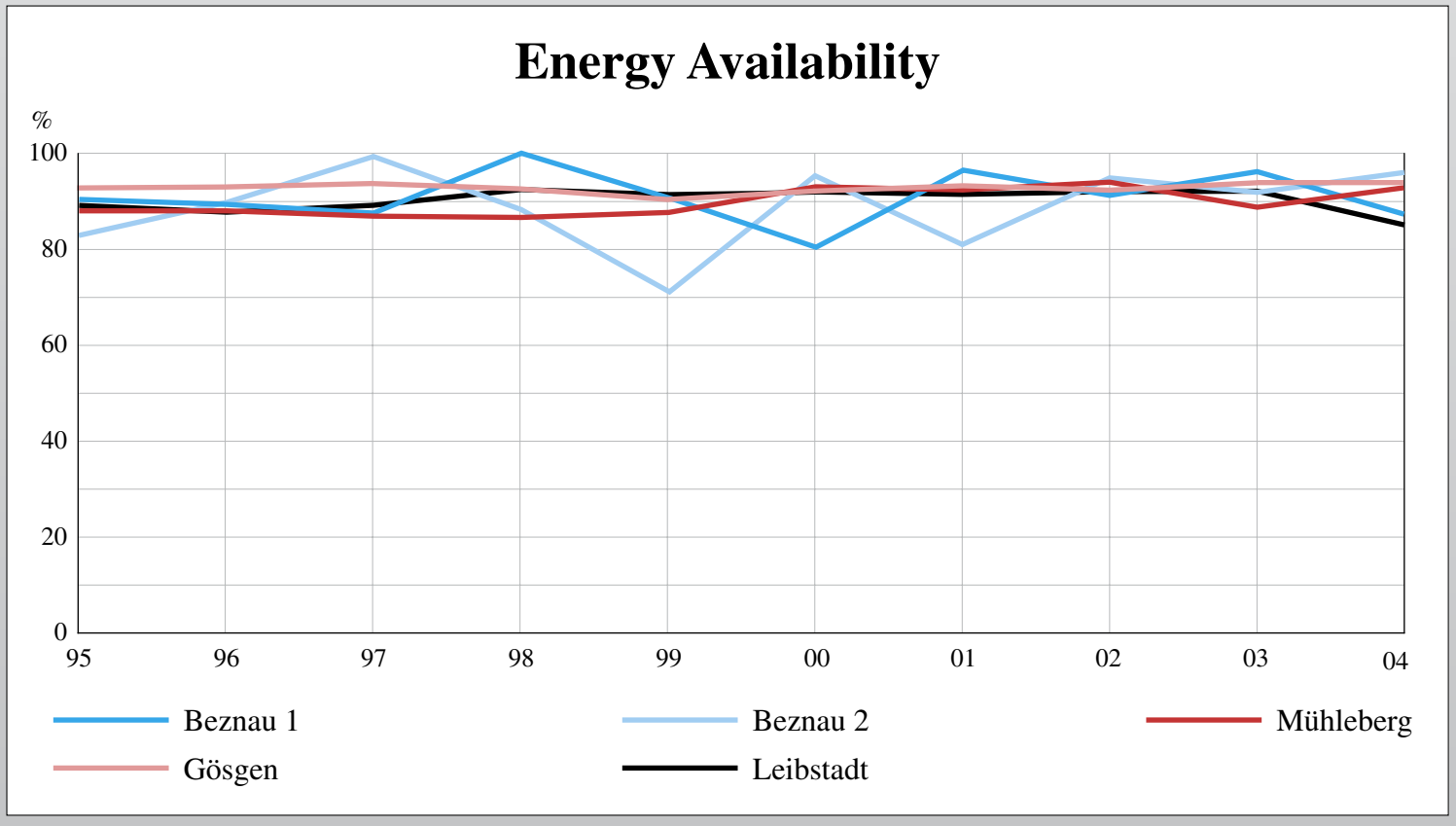
A new nuclear energy act came into force in Switzerland on 1st February 2005, bringing new restrictions but still leaving open the option of further investments in nuclear power. The Swiss nuclear power industry has recently celebrated a number of milestones. At the end of 2004, the nuclear power station at Gösgen celebrated 25 years of operation. At the beginning of 2005, Leibstadt celebrated 20 years. In 2004, Switzerland's five nuclear power plants reached again a high level of security, availability and competitiveness.

Peter Hirt
President Swissnuclear

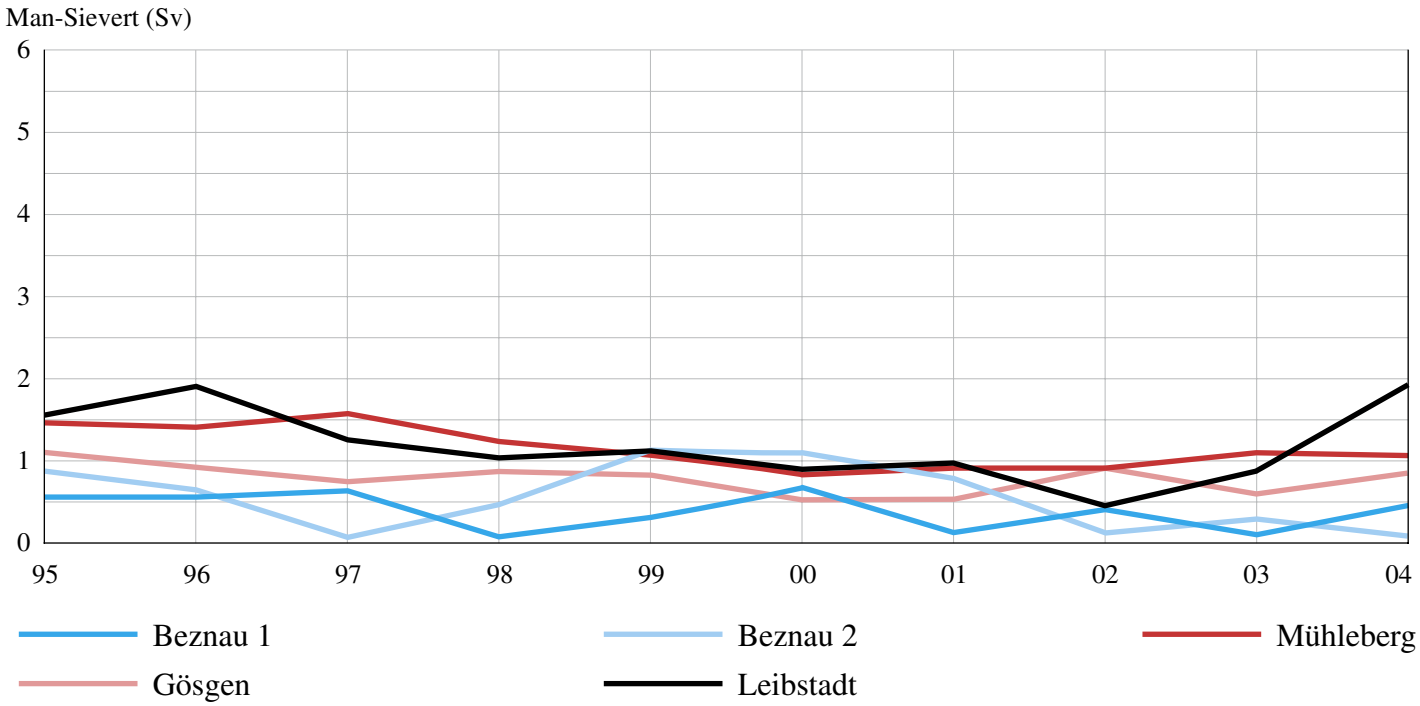
Kurt Kohler
President Group of the Managers of Swiss NPP's

Swiss Nuclear Power Plants: Production Figures 2004 and History

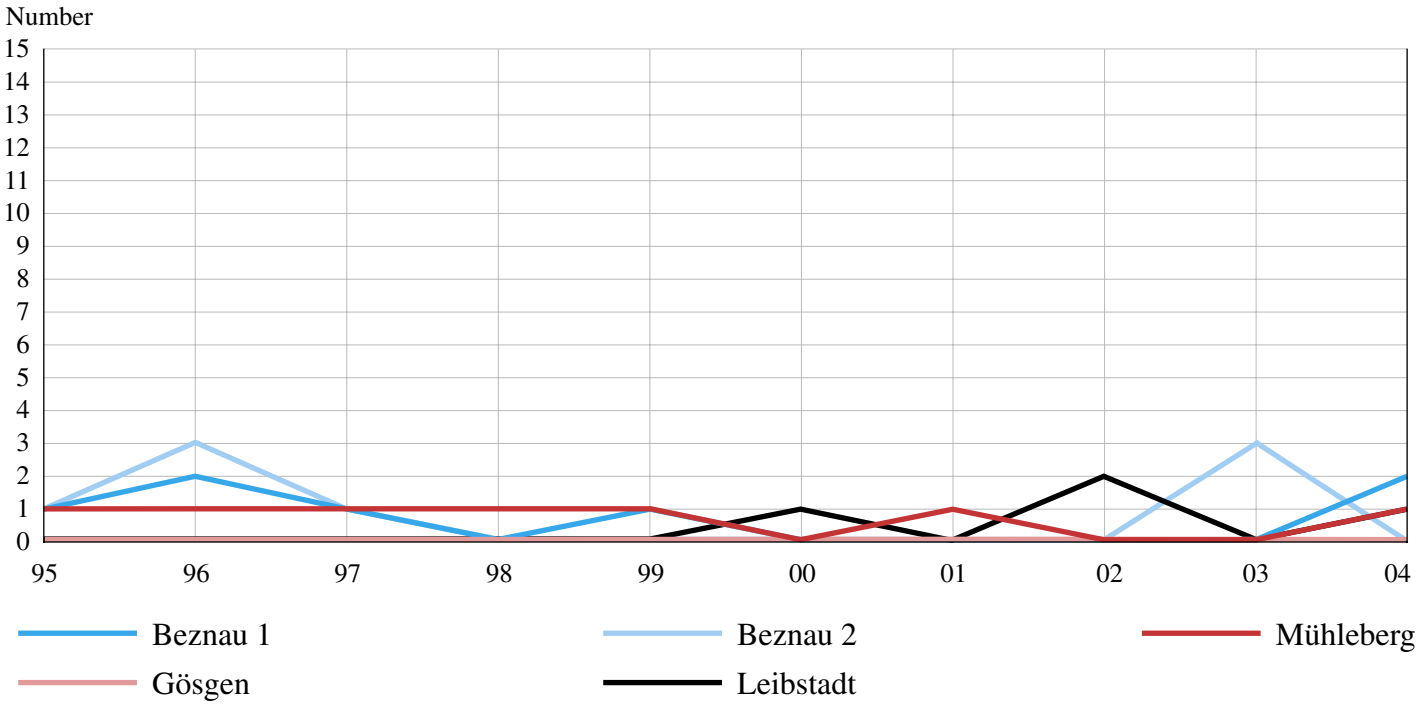
	Gross production MWh	Net production MWh	Total operating time (power production) h	Total gross production since start of operation MWh	Total net production since start of operation MWh
KKB 1	2 920 456	2 799 969	7758	93 220 507	89 186 086
KKB 2	3 226 597	3 099 368	8547	92 781 519	88 906 275
KKM	3 028 750	2 906 119	8282	84 859 965	81 063 057
KKG	8 458 425	8 015 604	8300	196 961 499	185 851 120
KKL	9 135 140	8 692 042	7632	167 695 303	158 985 524



Collective Exposure

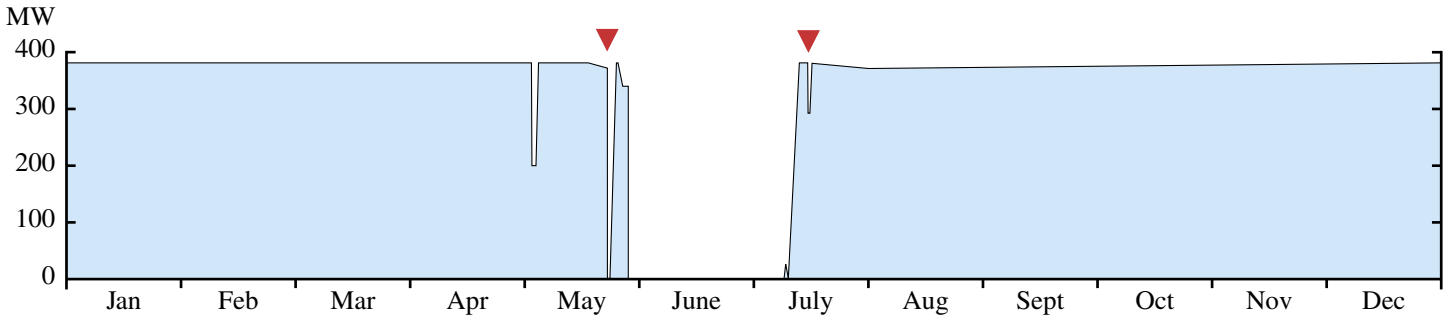


Reactor Scrams



Beznau 1

Operating Experience 2004



Important to Safety

Scrams:

There were two automatic scrams during power operation.

May 24: The loss of one of the two main feed water pumps in the secondary circuit caused an automatic shut down of the reactor. The automatic change over to the third feed water pump, which serves as standby pump, could not take place because this pump was already disconnected to undergo maintenance.

July 14: During the restart of the plant after the refuelling outage and while testing the new turbine control system, an automatic shut down of the reactor at a load of 14 % occurred. This scram was caused by the failure of a feed water circuit control valve.

Other:

December 14: The periodic safety examination for Beznau 1 was completed. The Swiss Federal Nuclear Safety Inspectorate (HSK) summarised in its technical commentary that high levels of security exist in both unit 1 and 2.

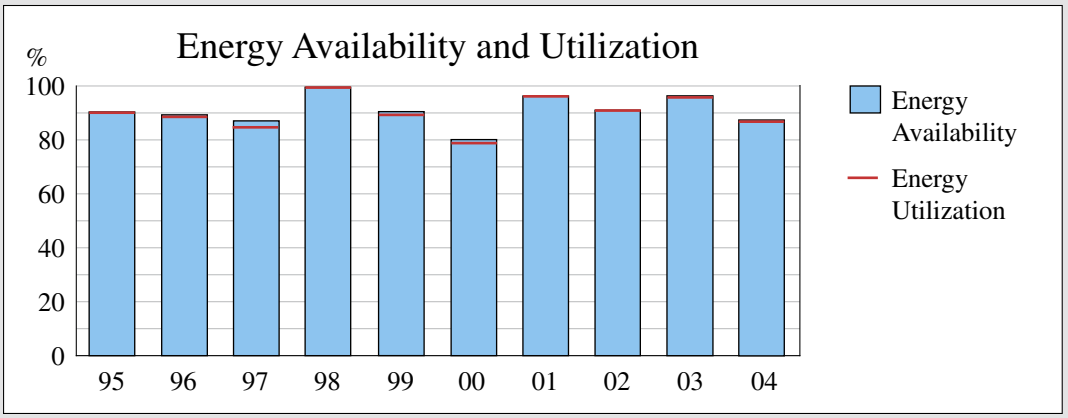
Year 2004: In May, a review of the Integrated Management System (IMS) and its extension to include conventional safety was successfully completed. The final report stated that the management system fulfils all requirements of the international standards ISO 14001 and OHSAS 18001. The certification took place at the beginning of July.

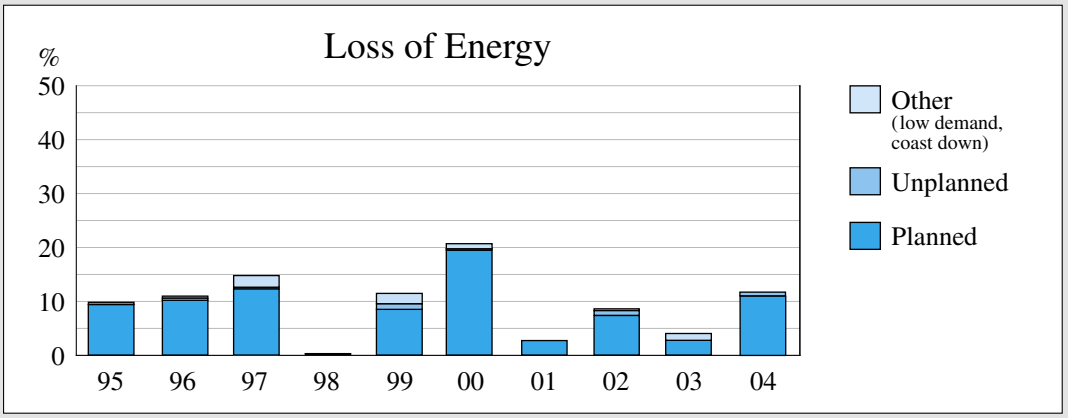
Important to Availability

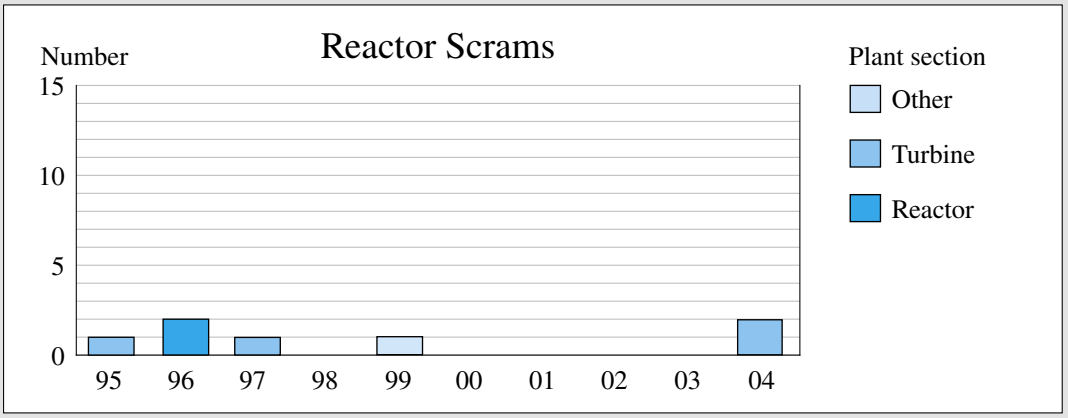
May 2: An automatic disconnection of one of the two turbines led to a corresponding load reduction of the unit. The scram was caused by a turbine preheating system.

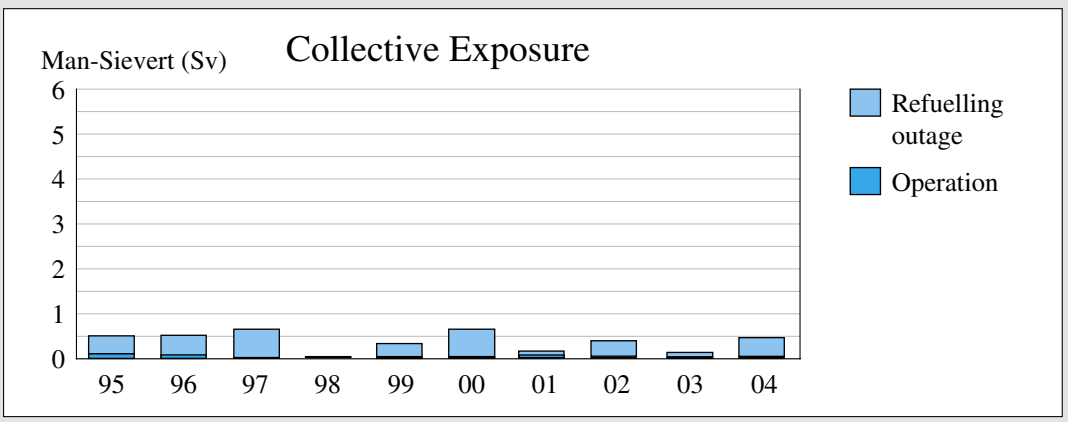
Refuelling outage May 29 to July 10: The refuelling outage lasted 42 days. Twenty-four from a total of 121 fuel elements were replaced. The new elements contain enriched reprocessed uranium. The main emphasis of the revision was the ultrasonic inspection of welding seams on the reactor pressure vessel, its head and the supply nozzles. For the first time, KKB made use of a remote controlled under water manipulator whose examination tools are interchangeable. The nuclear cooling system was subjected to a pressure test and the containment passed a leak tightness test. All examinations showed the plant condition to be in good order. Other tasks were the installation of new hydrogen recombiners, the inspection of a high-pressure turbine and the installation of an advanced turbine protection and control system.

History

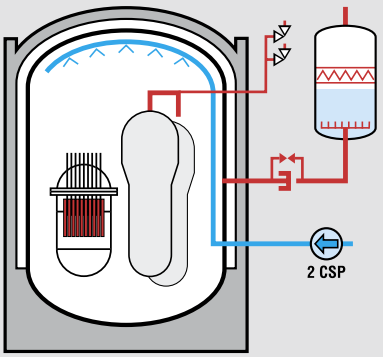


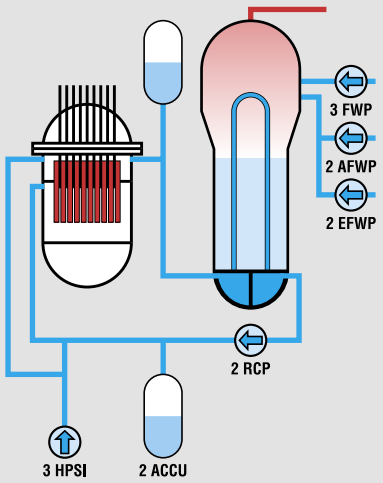


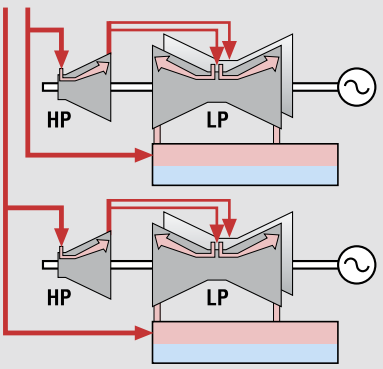


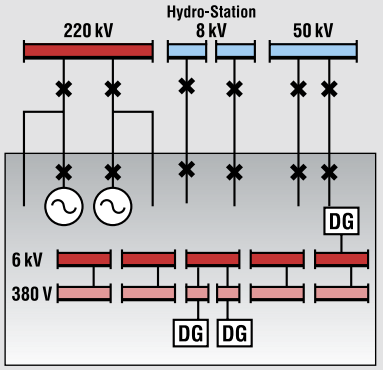


Characteristics



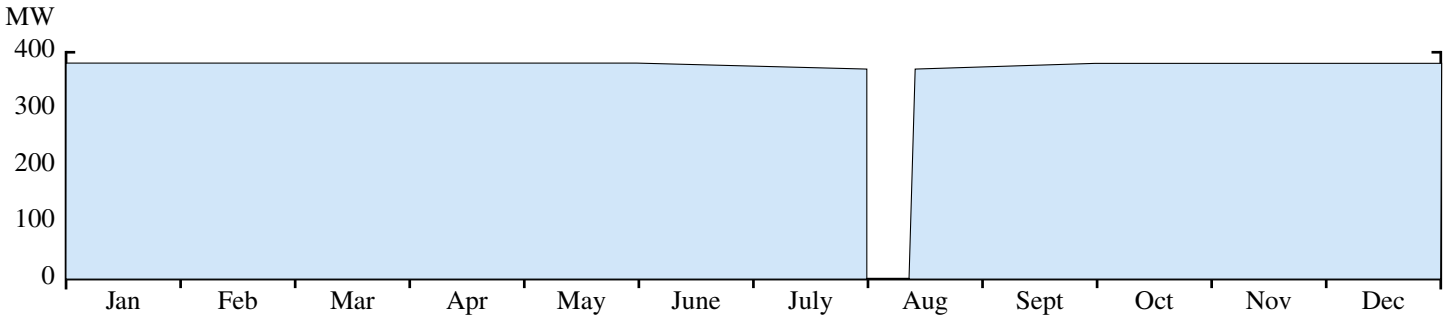






Beznau 2

Operating Experience 2004



Important to Safety

Scrams:

There were no automatic scrams during power operation.

Other:

Year 2004: In May, a review of the Integrated Management System (IMS) and its extension to include conventional safety was successfully completed. The final report stated that the management system fulfils all requirements of the international standards ISO 14001 and OHSAS 18001. The certification took place at the beginning of July.

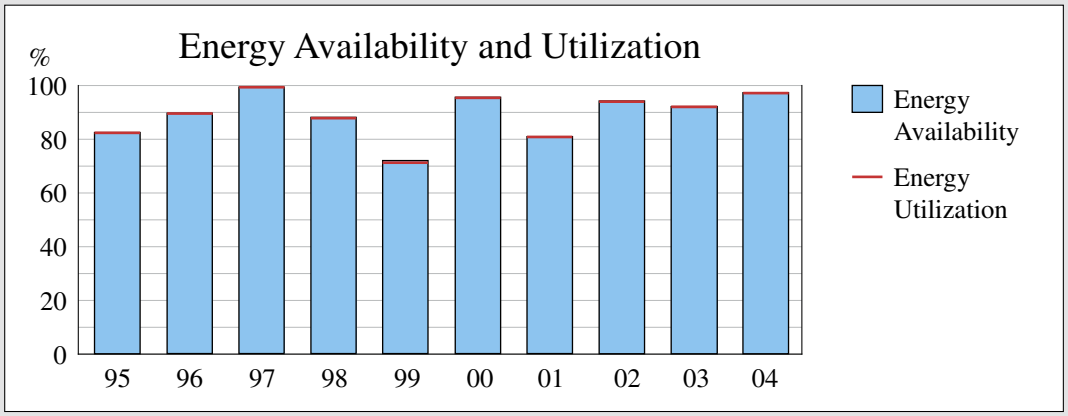
Important to Availability

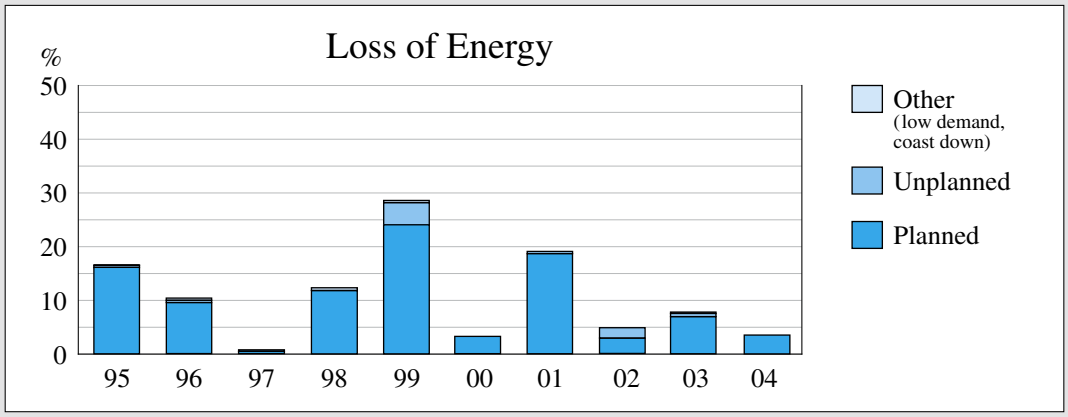
Refuelling outage July 31 to August 10: The refueling outage lasted ten days and served to replace 16 from a total of 121 fuel elements. The new elements contain enriched reprocessed uranium.

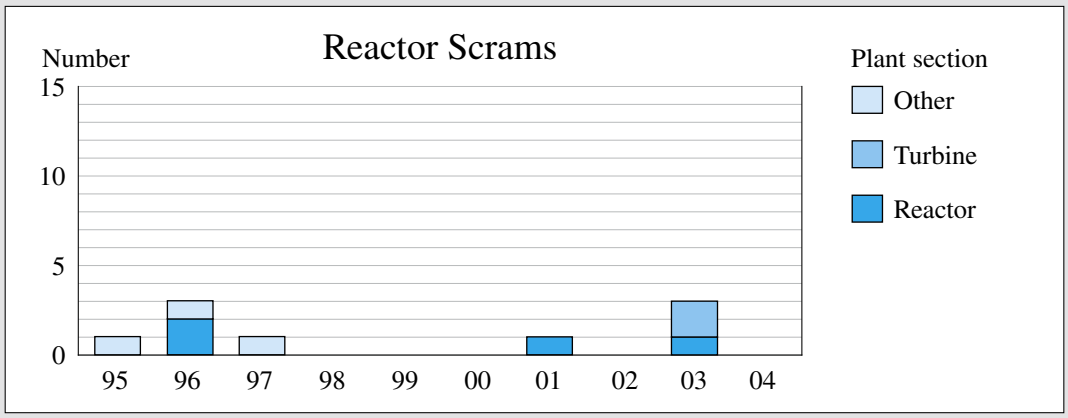
December 3: The Swiss Federal Council issued an unlimited operation licence for Beznau 2 and in response to the corresponding application which the owner, Nordostschweizerische Kraftwerke AG (NOK), had submitted in November 2000. KKB-2, which entered into operation in 1972, now has the same type of operating licence as the identical unit 1. Unit 1, which started operation two years earlier than unit 2, has an unlimited operating licence since the commissioning of the plant.

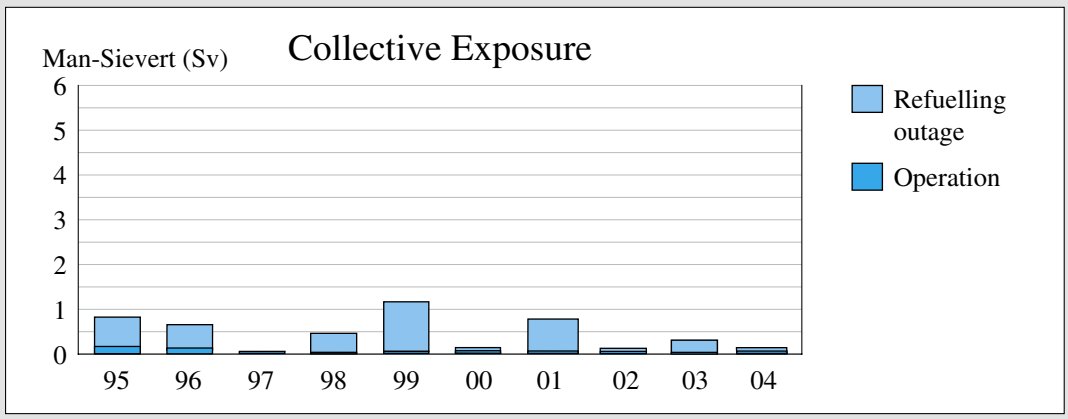
History

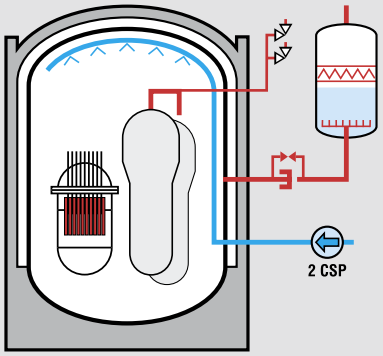
Characteristics

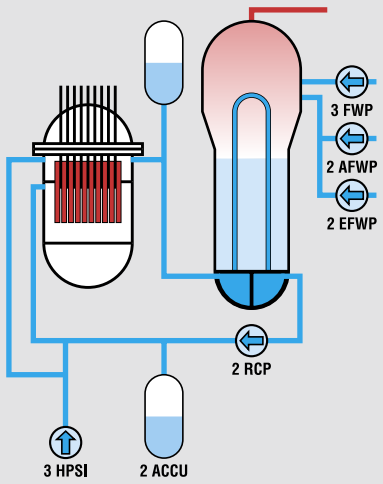


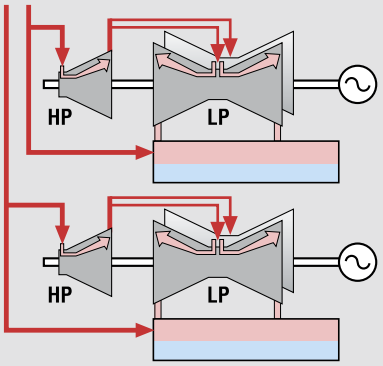


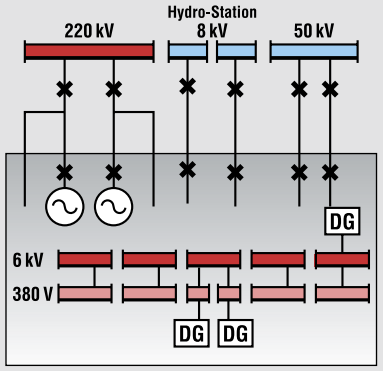






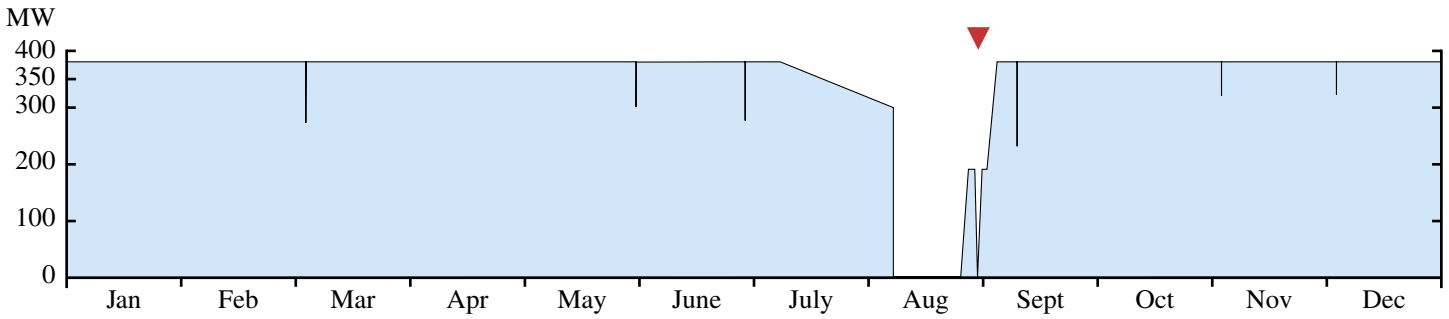






Mühleberg

Operating Experience 2004



Important to Safety

Scrams:

There was one automatic scram during power operation.

August 30: During the test of the newly installed pressure control systems of both turbine trains, an automatic isolation of the MSIVs due to low steam pressure occurred and a consequential scram took place. The cause was a logic mismatch in the control of one vacuum limiter, part of the newly installed systems. The scram happened during the planned test phase performed during the plant start-up after refueling.

Other:

Year 2004: The plant's specific quality assurance system, implemented in 1998, evolved into a quality management system built to the international standards ISO 9001: 2000, ISO14001:2004 and OHSAS18001:1999. The certification took place in December 2004.

Important to Availability

July 11: The planned coast-down operation began. The power at end of cycle reached 92.4%.

Refueling outage August 8 to August 27: The planned refueling outage lasted 20 days. In-service inspections and non-destructive tests of the reactor pressure vessel were successfully carried out. One of the four built-in tie rods was inspected. The pressure control systems and the high pressure preheater turbine A were replaced. Forty out of 240 fuel elements were replaced.

Load reductions:

A total of nine load reductions (> one full power hour) occurred.

Two unplanned load reductions took place. The first was caused by the malfunction of a logic control card of a generator differential protection system on June 29. The second was the scram on August 30.

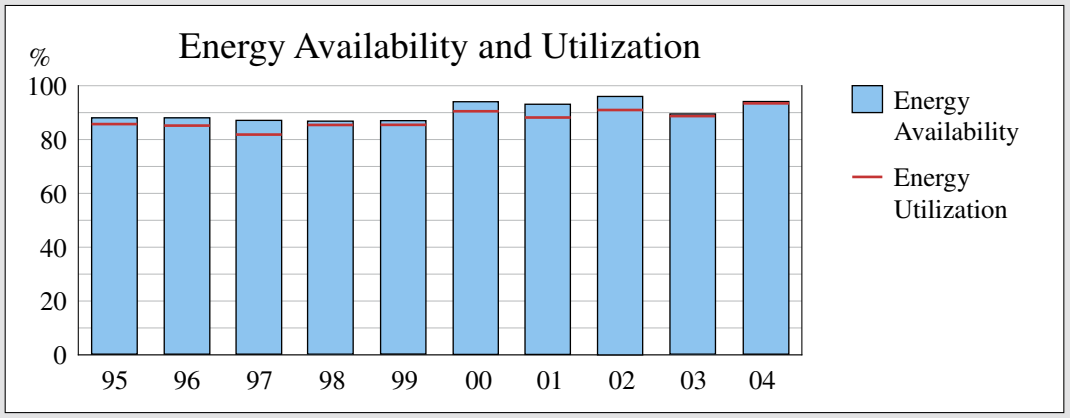
Four planned load reductions were carried out for periodic surveillance tests, combined with rod pattern adjustments and preventive maintenance.

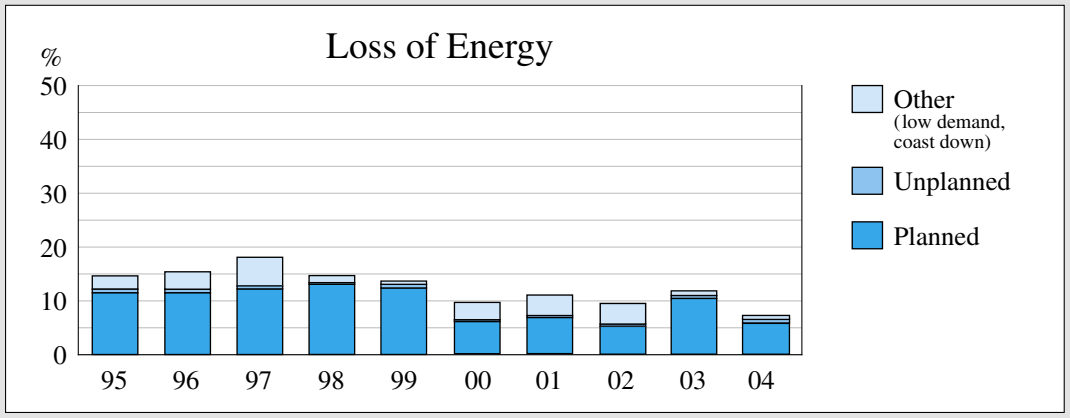
One planned load reduction was required to search for small air ingress into the turbine con-densers.

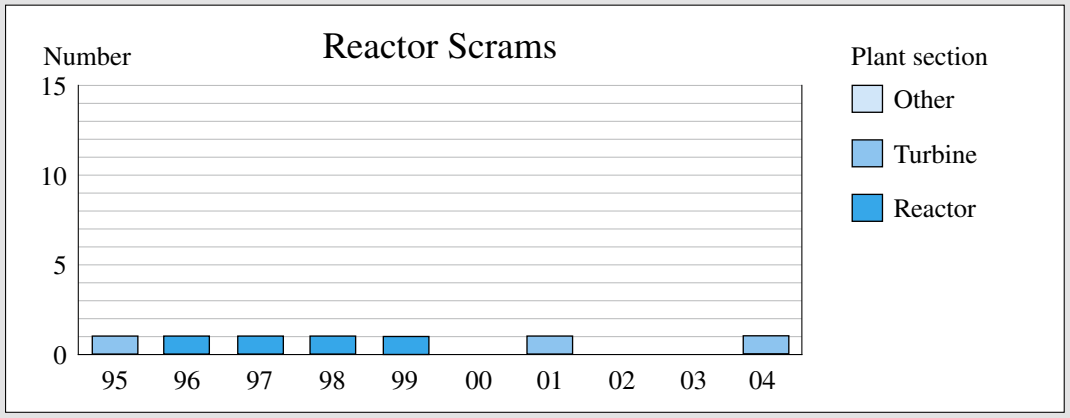
From July 18 to August 8 and September 5 to 16, two planned load reductions were made due to high temperature of the cooling water.

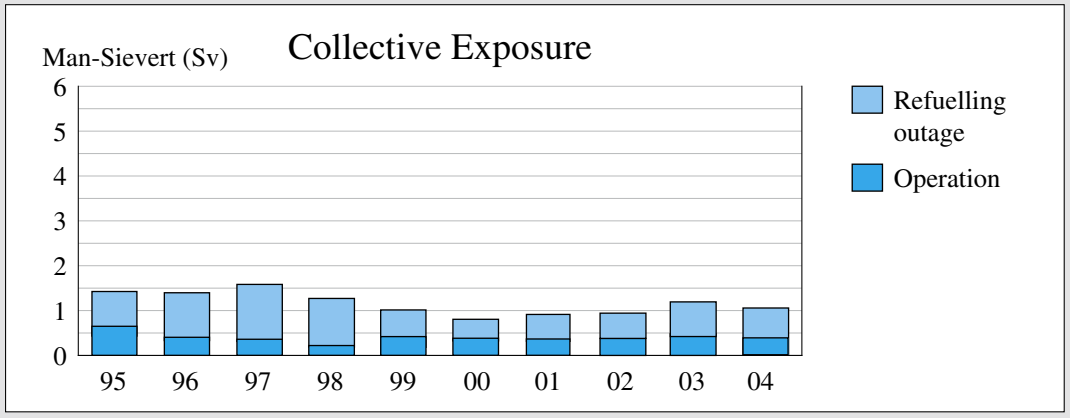
History

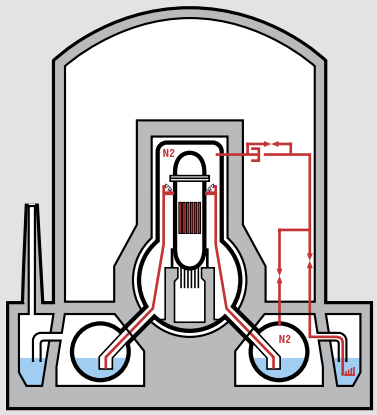
Characteristics

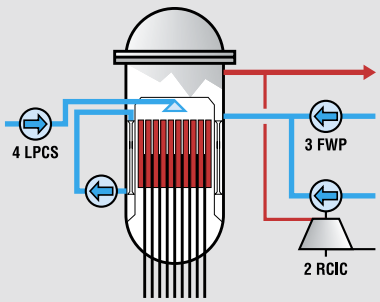


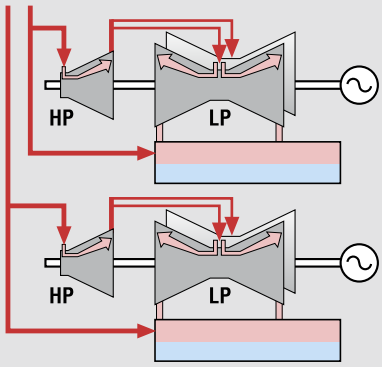


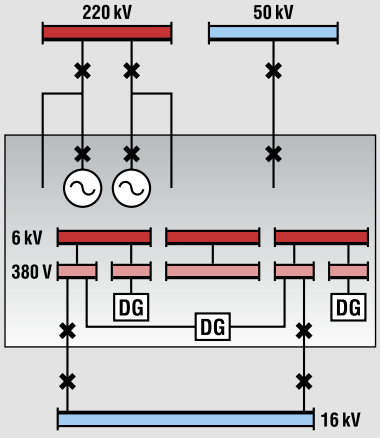




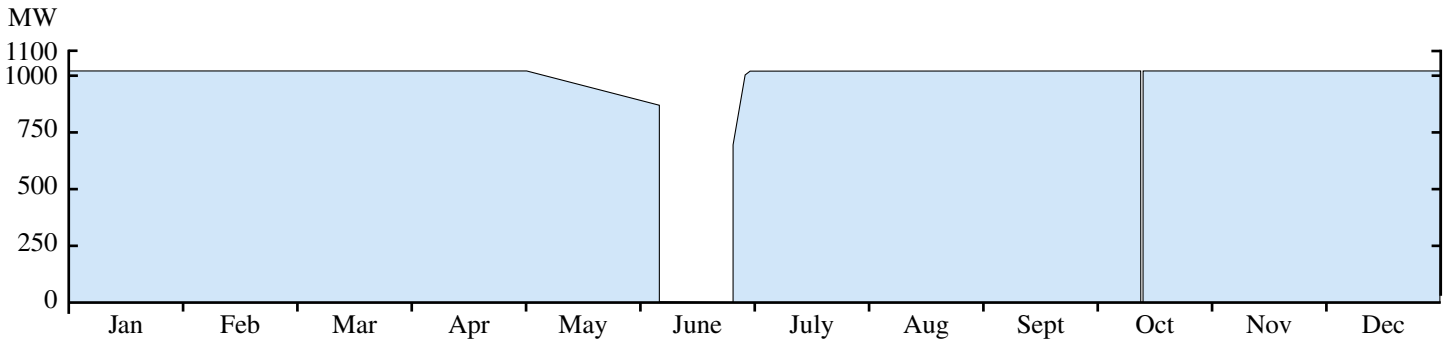








Operating Experience 2004



Important to Safety

Scrams:

2004 was the 14th consecutive year of operation without unplanned scrams.

Important to Availability

After record production in 2003, KKG achieved production of 8458 GWh in 2004, a new record.

May 2: Start of coastdown operation. The power level at the end of the cycle was 90 %. Coastdown operation led to a production loss of about 2 equivalent full power days.

Refuelling outage, June 5 to June 24:

The duration of the refuelling outage was 19 days, half a day longer than scheduled.

In addition to general preventive maintenance and inspection work, the following major work was performed:

- Inspection and replacement of the seals of two main coolant pumps.
- Loading of 44 new ERU fuel elements. No new MOX fuel elements were loaded for the 26th cycle.
- U-tube testing in two steam generators.
- Replacement of a high-pressure feedwater heater.
- Battery replacement in one train.
- Installation of a new vibrations-diagnostic system for the turbine-generator set.
- Cleaning of the tube plate in all steam generators.

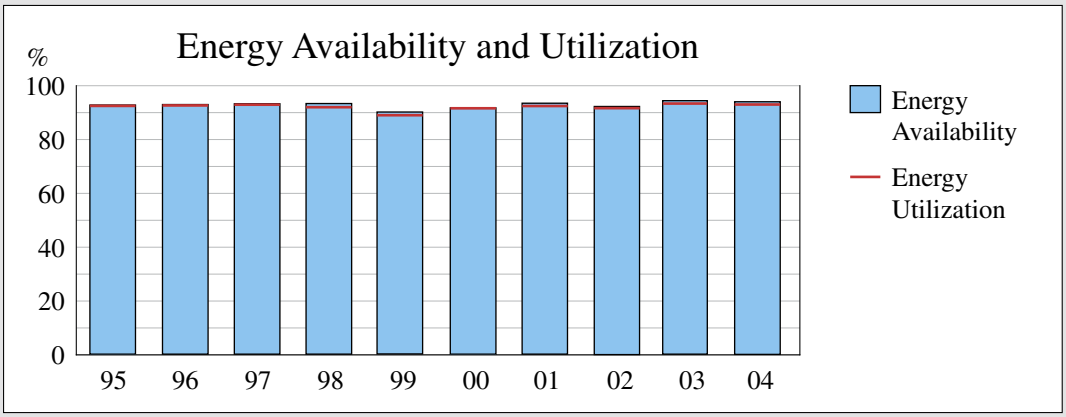
October 12 to 13: Cold-shutdown of the plant to repair a leak in a welding seam of a control valve of the main steam isolation valve.

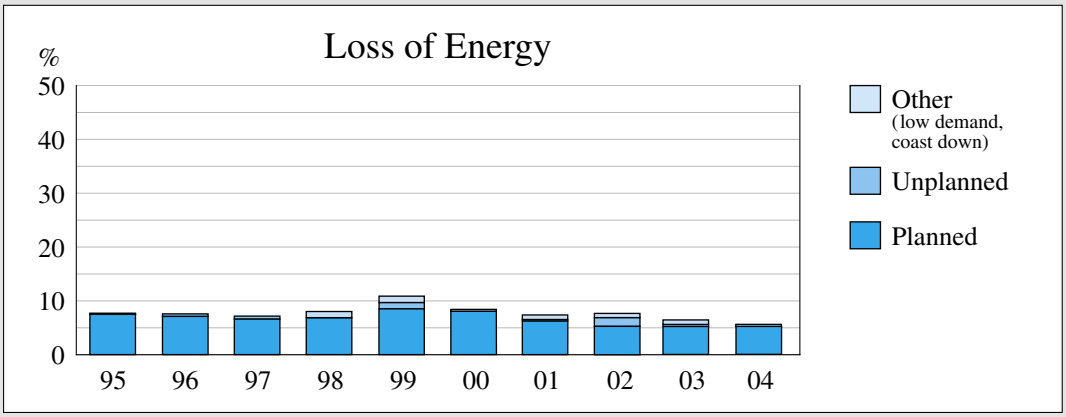
Other:

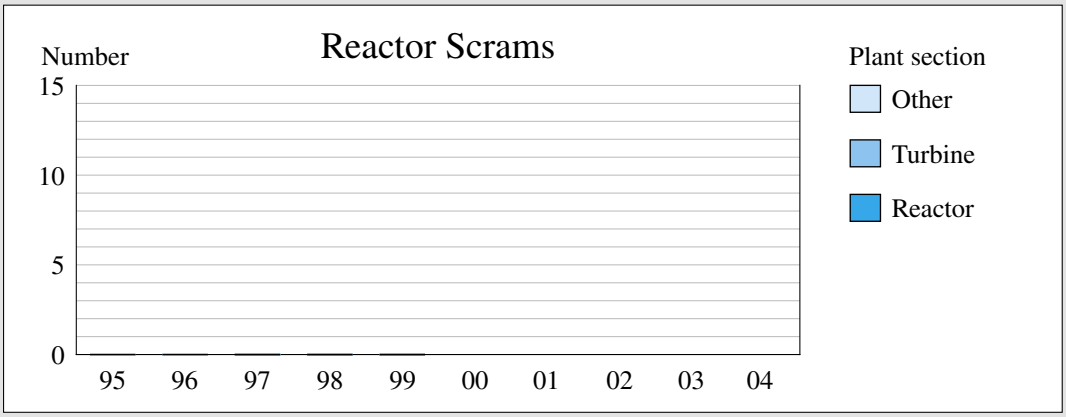
In 2004, a quality management system (based on the standards ISO 9001:2000; ISO 14001:1996 and OHSAS 18001:1999) was implemented. The successful certification took place in April.

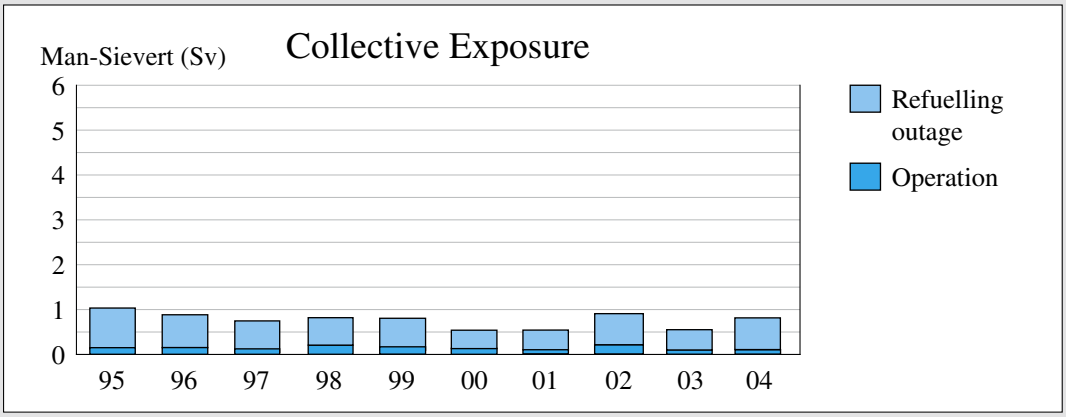
History

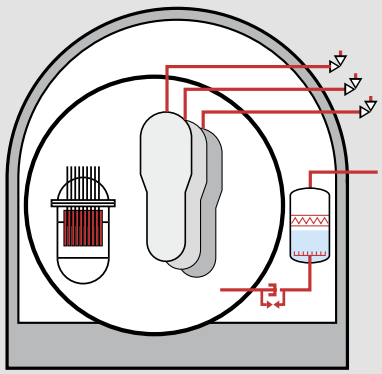
Characteristics

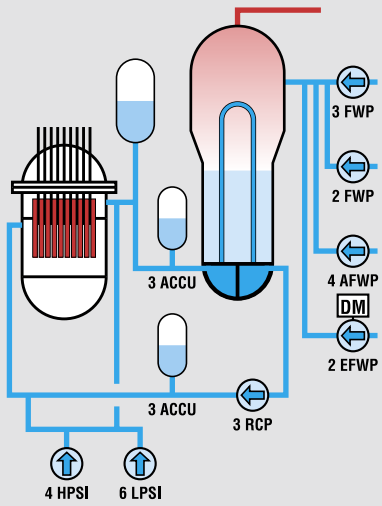


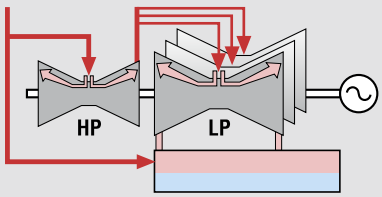


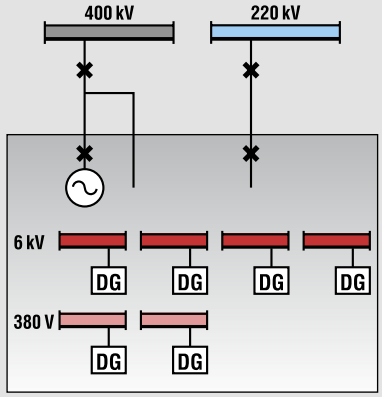






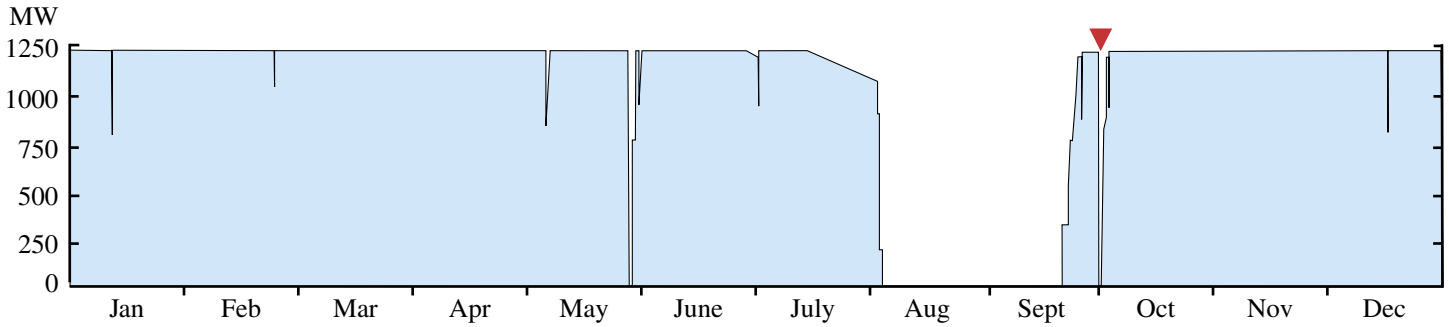






Leibstadt

Operating Experience 2004



Important to Safety

Scrams:

There was one automatic scram during power operation.

October 1: Loss of excitation to the Main Generator resulted in a reactor scram per plant design.

Important to Availability

January 17: MSIV monitoring and control rod pattern adjustment.

February 25: Reactor recirculation system runback (decrease in reactor core flow).

May 7: MSIV monitoring

May 27 to 29: Planned shutdown to repair source of unidentified leakage in the drywell.

June 1: Control rod pattern adjustment.

July 3: Control rod pattern adjustment.

July 15: Start end-of-cycle coastdown

August 7 to September 21: 20th refuelling outage

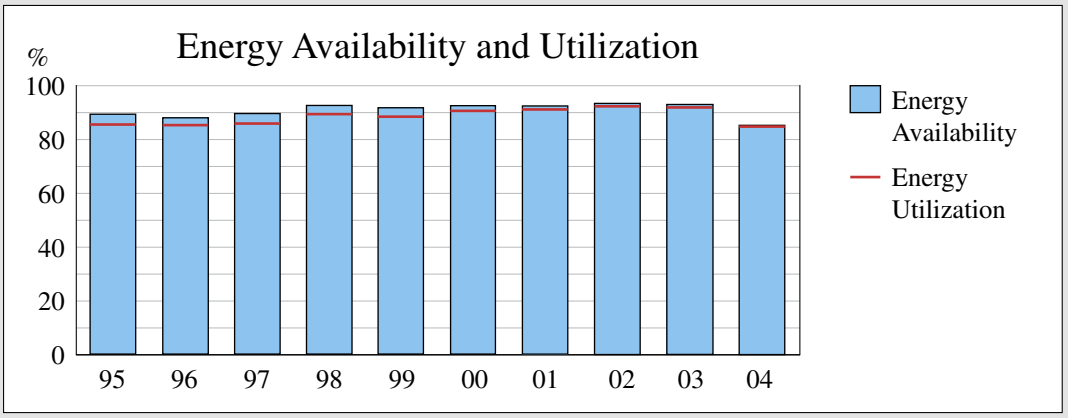
Duration was 44.97 days (scheduled 35.75). Loaded 124 new fuel bundles (out of 648)

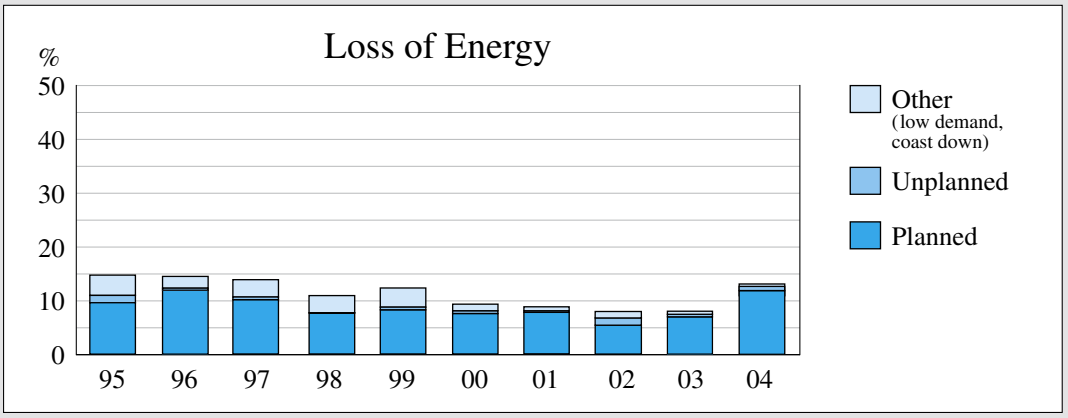
October 1: Automatic Scram (see Important to Safety).

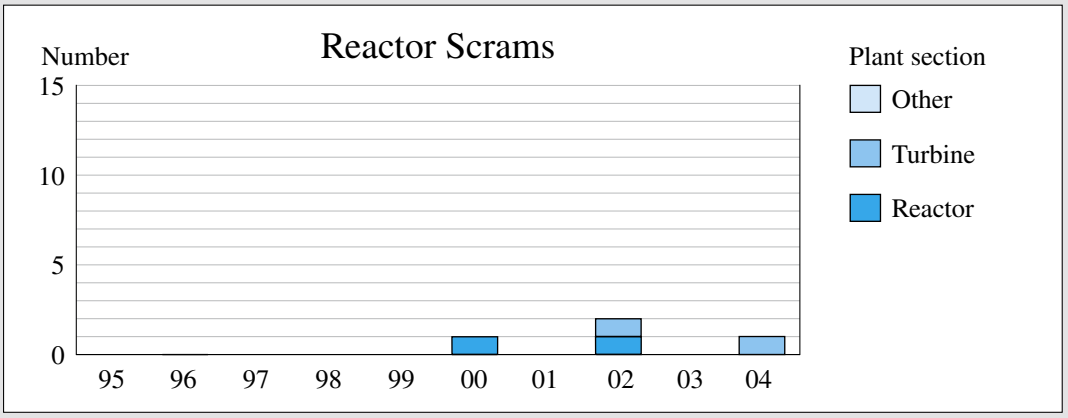
December 18: MSIV monitoring and control rod pattern adjustment.

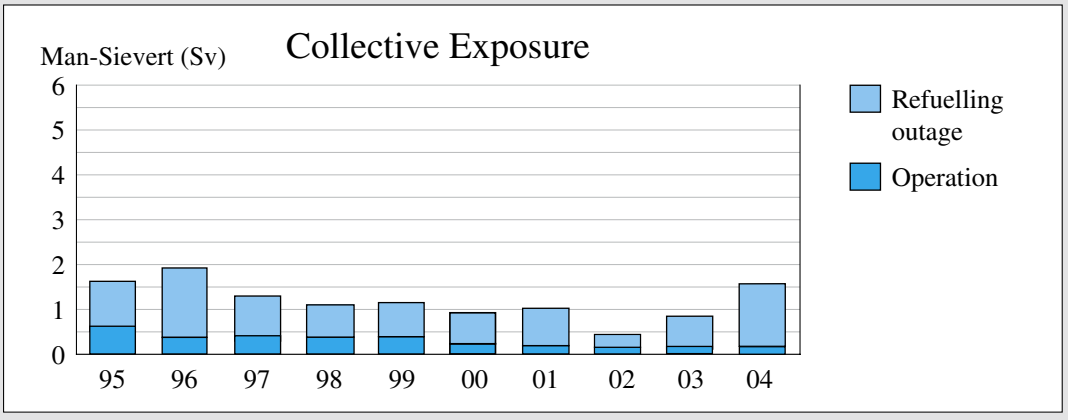
History

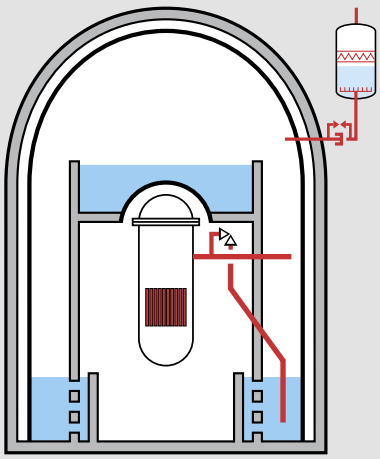
Characteristics

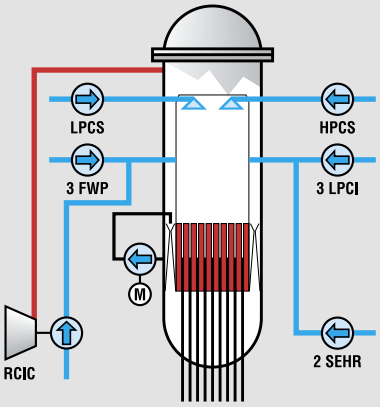


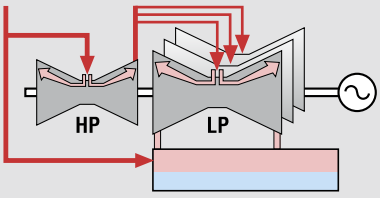


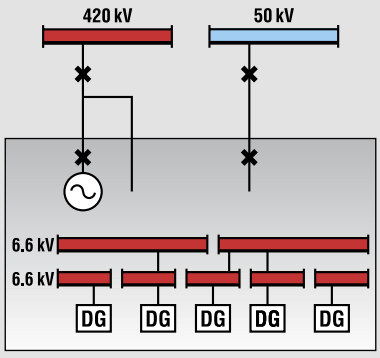












The first two Swiss nuclear power plants, Beznau and Mühleberg, each belong to a single large public electric utility, whereas the two later plants, Gösgen and Leibstadt, are partner plants of several electric utilities and public service companies. The concept of partner nuclear power plants made it possible, when they were set up in the seventies, for medium-sized and smaller organisations to share in economically attractive, large-scale power generation plants and to gain access to the latest technology. In each case one of the partners has responsibility for the business management on behalf of the others.

The Beznau nuclear power plant is fully owned by its operator, Nordostschweizerische Kraftwerke.

Likewise, the Mühleberg nuclear power plant belongs fully to BKW FMB Energie AG.

The partners of Kernkraftwerk Gösgen-Däniken AG (KKG) are:
– Aare-Tessin AG für Elektrizität (ATEL, 40%, managing partner)
– Nordostschweizerische Kraftwerke (NOK, 25%)
– the City of Zurich (15%)
– Centralschweizerische Kraftwerke (CKW, 12.5%)
– the City of Berne (7.5%)

Kernkraftwerk Leibstadt AG (KKL) is owned by the following partners:
– Nordostschweizerische Kraftwerke AG (NOK, 22.8%, managing partner)
– Aare-Tessin AG für Elektrizität (ATEL, 27.37%)
– Elektrizitäts-Gesellschaft Laufenburg AG (EGL, 16.28%)
– Centralschweizerische Kraftwerke (CKW, 13.57%)
– BKW FMB Energie AG (9.55%)
– AEW Energie AG (5.43%)
– Energie Ouest Suisse, Lausanne (EOS, 5%)

NOK

Nordostschweizerische Kraftwerke
Parkstrasse 23
CH-5401 Baden
Phone +41-56-200 31 11

BKW

BKW FMB Energie AG
Viktoriaplatz 2
CH-3000 Berne 25
Phone +41-31-330 51 11

Kernkraftwerk Gösgen

Kernkraftwerk
Gösgen-Däniken AG
CH-4658 Däniken
Phone +41-62-288 20 00

KKL

Kernkraftwerk Leibstadt AG
CH-5325 Leibstadt
Phone +41-56-267 71 11

Copies of this report are available from:
OPEX Swiss Nuclear Power Plants
P.O. Box 5032
CH-3001 Berne
Phone +41-31-320 65 25
Telefax +41-31-320 68 31
E-mail: info@atomenergie.ch