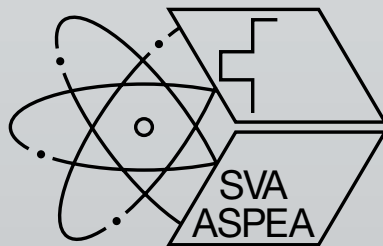


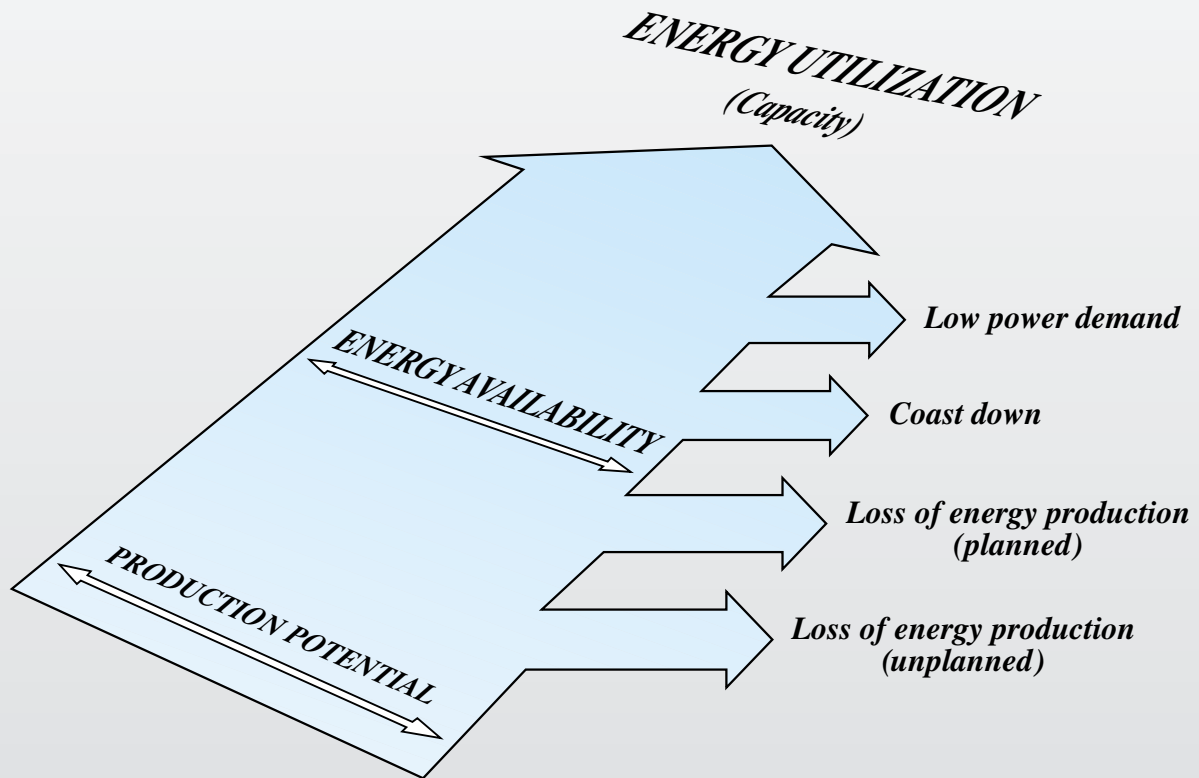
2004

Summary of
Operating Experience
in Swiss Nuclear Power Plants

2003



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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 – E_{tg}/E_n
(UNIPEDE definition 4.6.03.f)

Energy utilization factor – E_d/E_n
(UNIPEDE definition 4.5.01)

E_n (Production Potential)

– energy producible assuming maximum capacity continuously available throughout a specific period

E_d (Energy Utilization)

– energy actually produced within a specific period

E_{tg} (Energy Availability)

– energy producible assuming available capacity during a specific period

The five Swiss nuclear power reactor units continued their strong contribution to the national electricity supply in 2003. The nuclear share of overall electricity production in Switzerland was 40%. The net production of the nuclear park was 25.9 TWh – which was 1% higher than the previous year's record of 25.7 TWh.

Switzerland's nuclear power plants also achieved their primary goal in 2003 – that of continued safe production of electricity. Swiss nuclear plants still have many operational years ahead of them. Two key tasks remain constant: the need to ensure ongoing safe operation and to prepare for eventual replacement nuclear capacity.

The debate about the process of replacement nuclear capacity began in the spring of 2004.

Three important facts need to be considered:

- The degree of public acceptance of nuclear energy since the referendum of May 2003;
- Ensuring that general political and regulatory conditions are designed in a way that can provide for the construction of a new nuclear power plant in Switzerland;
- The realisation that «renewable energy» sources alone cannot compensate for the loss of generation from a nuclear power plant.

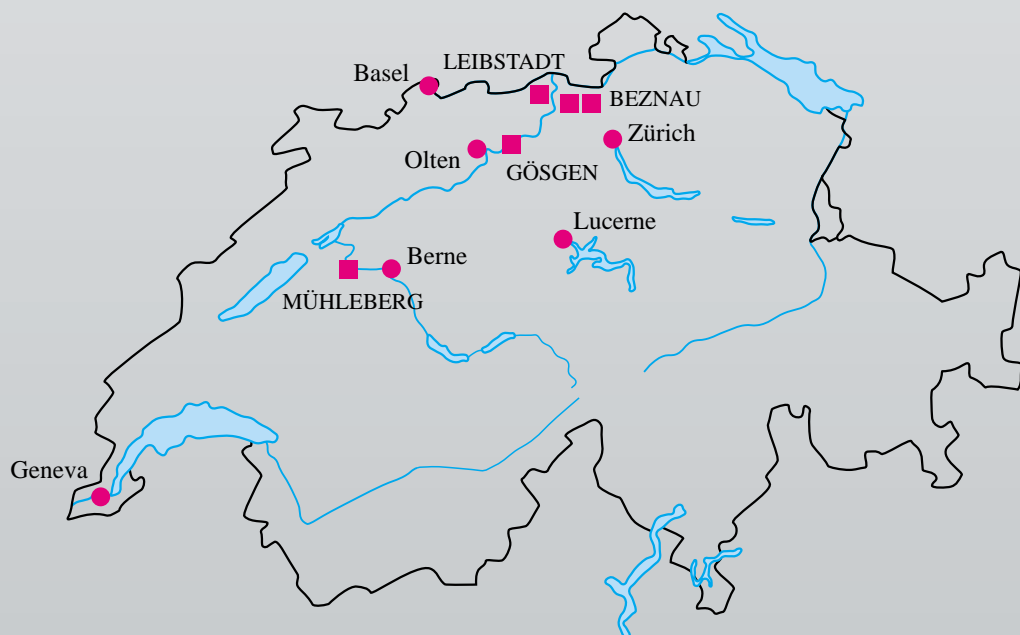
Swiss Association for Atomic Energy (SVA)

Bruno Pellaud

Dr. Bruno Pellaud, President

Peter Hählen

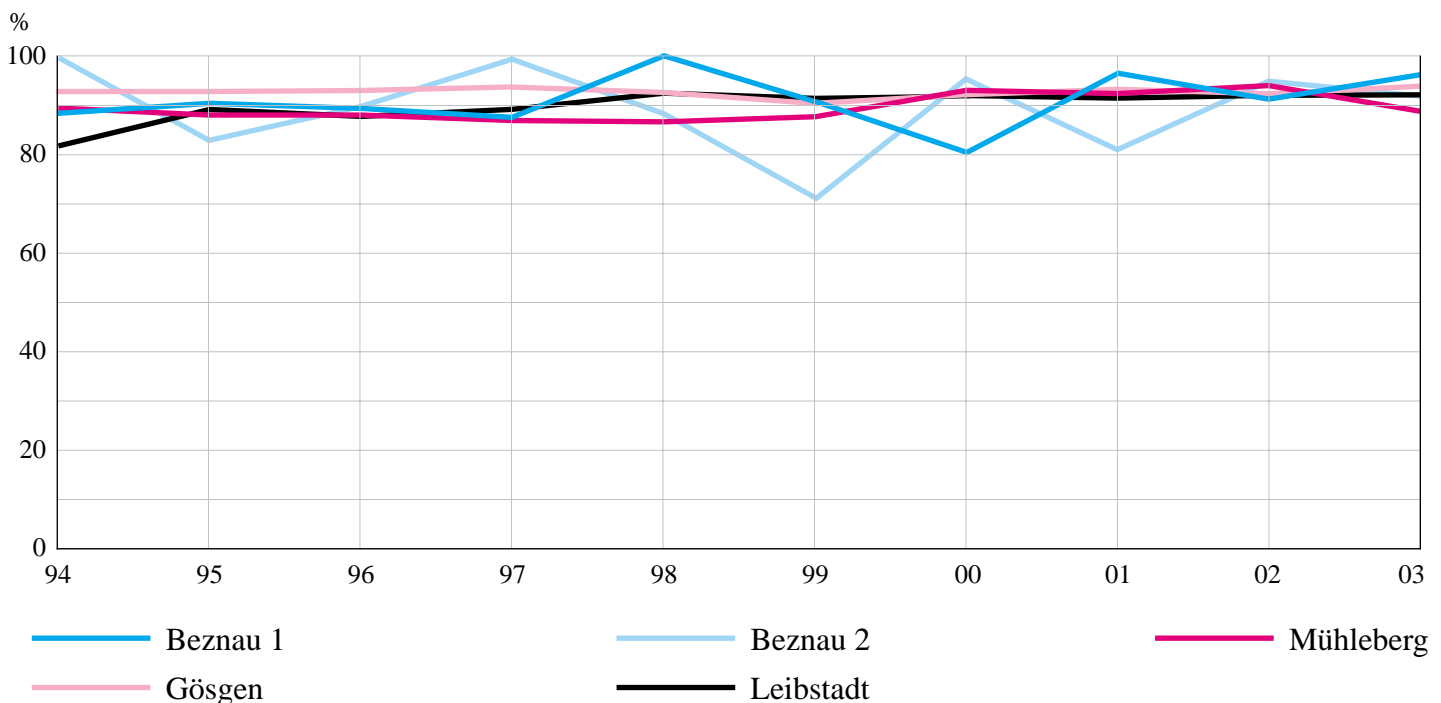
Dr. Peter Hählen, Secretary General



Swiss Nuclear Power Plants: Production Figures 2003 and History

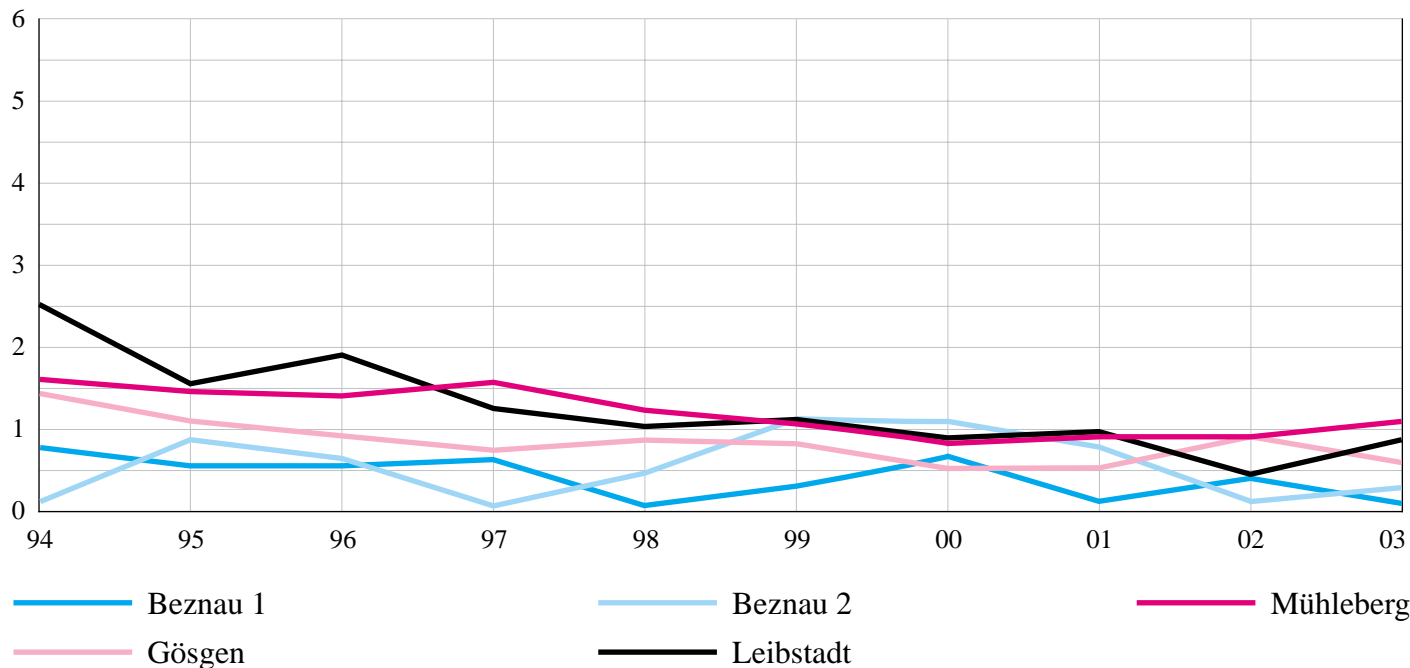
	Gross production MWh	Net production MWh	Total operating time (power production) h	Total gross production since start of operation MWh	Total net production since start of operation MWh
KKB 1	3 193 185	3 061 761	8520	90 300 051	86 386 117
KKB 2	3 042 864	2 920 287	8104	89 554 922	85 806 907
KKM	2 859 272	2 744 237	8035	81 831 215	78 156 938
KKG	8 442 947	7 988 680	8292	188 503 074	177 835 516
KKL	9 777 239	9 309 340	8204	158 560 163	150 293 482

Energy Availability



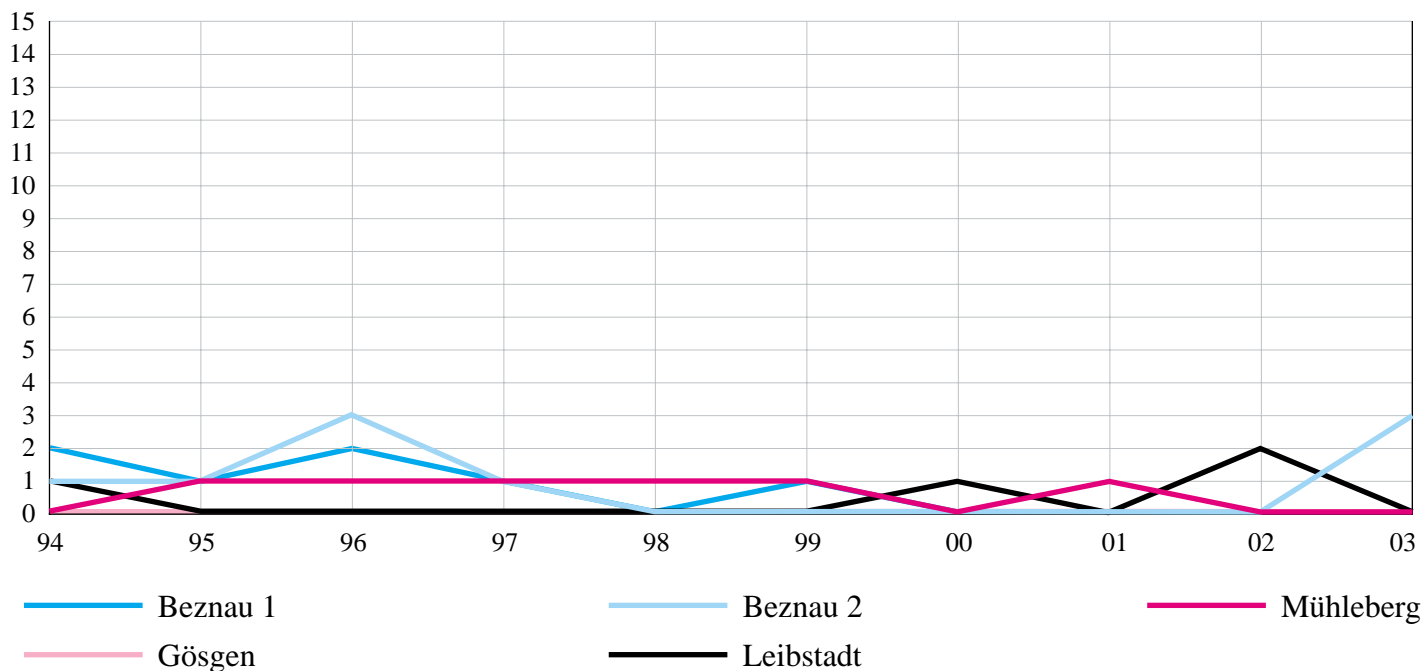
Collective Exposure

Man-Sievert (Sv)



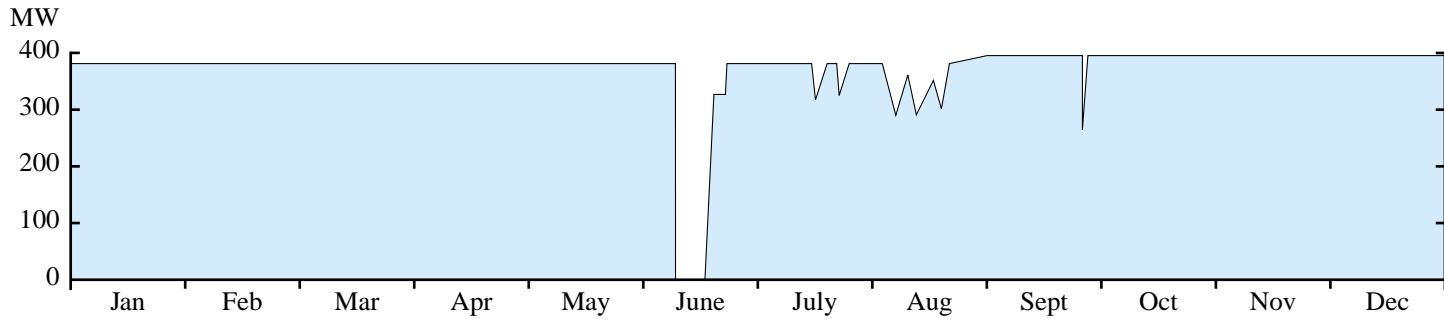
Reactor Scrams

Number



Beznau 1

Operating Experience 2003



Important to Safety

Scrams:

There were no automatic scrams during power operation.

Other:

Year 2003: The environmental management system that is based on the international standard ISO 14001 provided a solid basis for ongoing improvements. In the year 2003, the quality assurance programme – implemented in 1985 – evolved into a quality management system, attuned to the power plant processes and built up to the international standard ISO 9001:2000. The certification took place in May 2003.

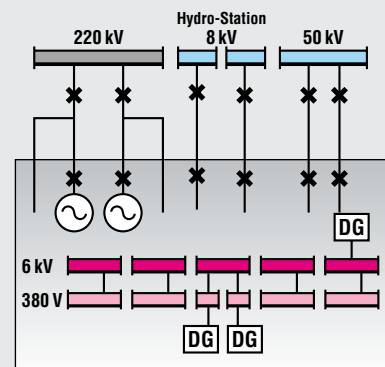
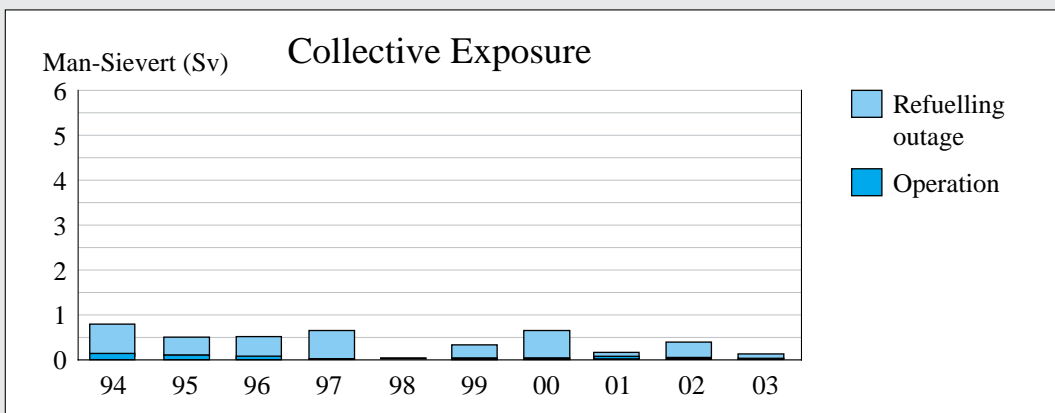
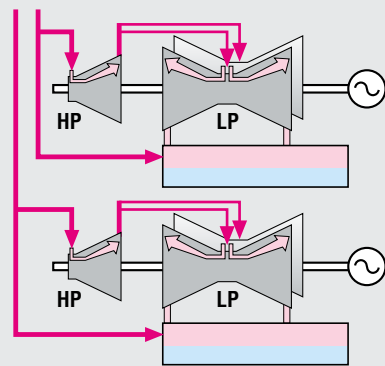
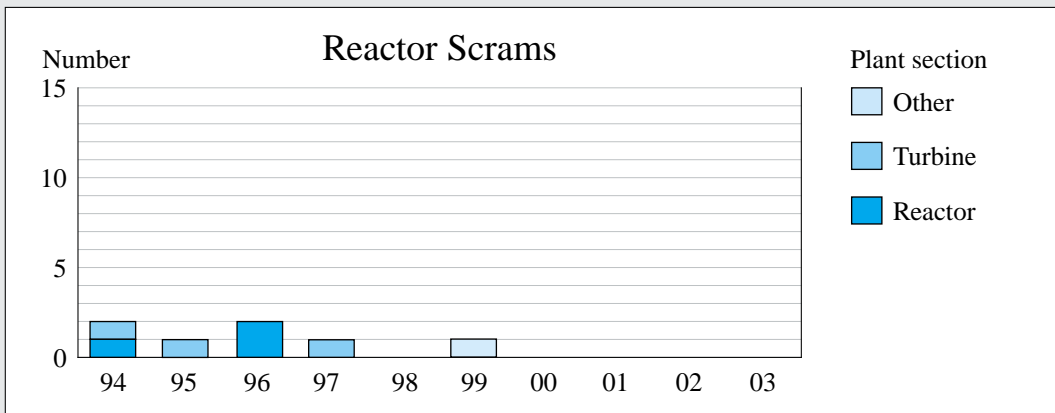
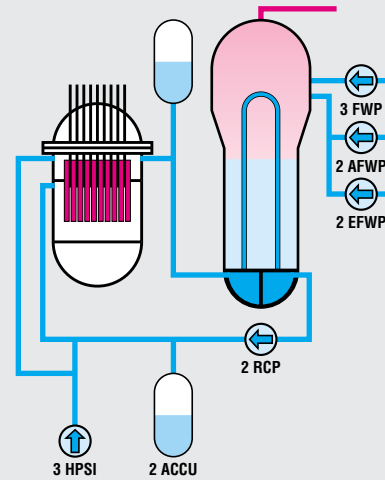
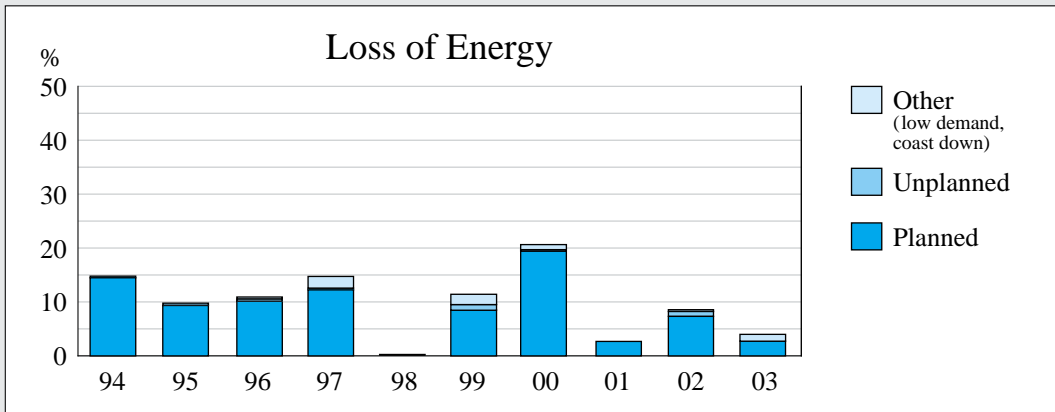
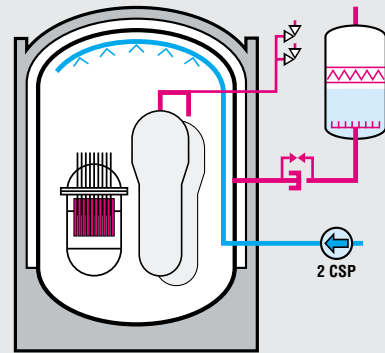
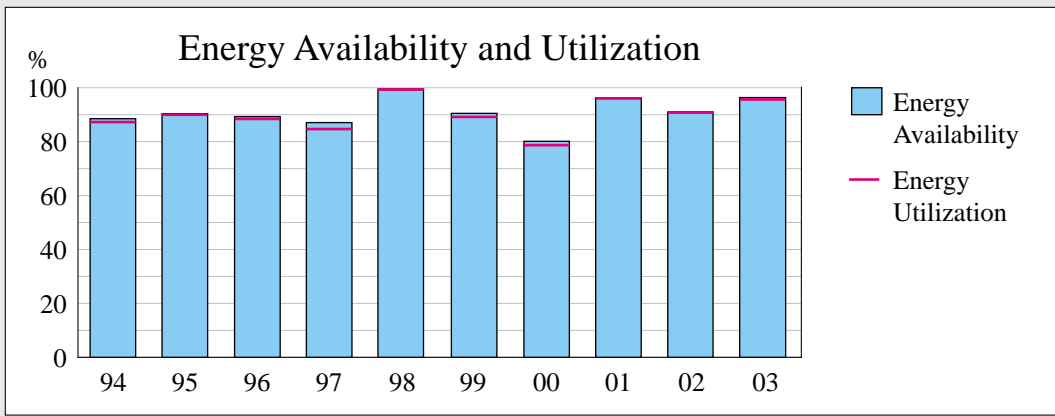
Important to Availability

Refuelling outage June 10 to June 21: Beznau 1 was shut down on June 10th for a refuelling outage after an interruption-free full power operation. The refuelling outage lasted only ten days and served to replace part of the total of 121 fuel elements. 8 of the new elements are uranium elements and 8 contain reprocessed uranium.

June, July, August: The very hot summer had some effects on the power production, as the temperature of the cooling water outlet to the Aare river is limited to 32°C. Load had to be reduced several times on various days.

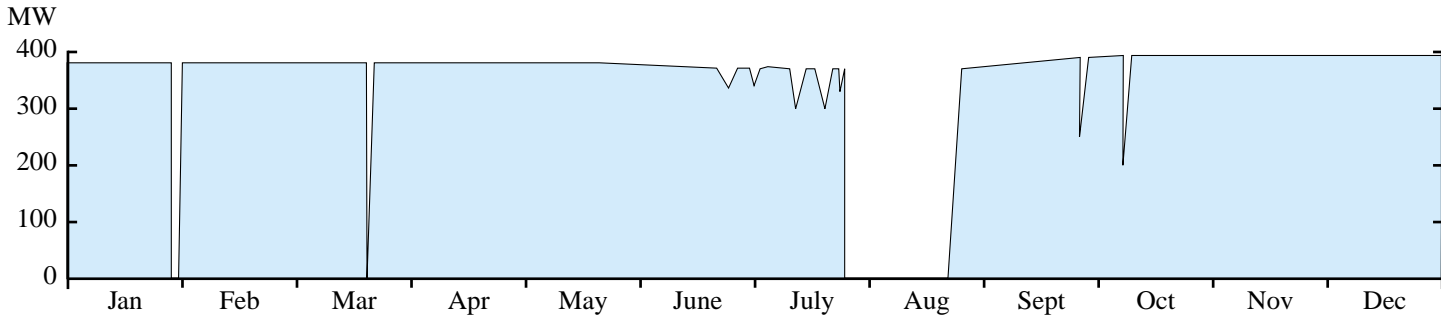
History

Characteristics



Beznau 2

Operating Experience 2003



Important to Safety

Scrams:

There were three scrams during power operation.

January 29: During a routine test of the oil pumps in the steam dump system (secondary side), the related valves opened unintentionally and caused the automatic shut down of both turbines and the reactor. The plant responded per design.

March 19: This automatic shut down of the reactor was caused by operator action during a routine test of electrical breakers. These breakers are part of the reactor protection system.

August 19: Scram during start-up after refuelling at a power level of 12%. Cause was a malfunction in the feed-water system.

Other:

Year 2003: The environmental management system that is based on the international standard ISO 14001 provided a solid basis for ongoing improvements. In the year 2003, the quality assurance programme – implemented in 1985 – evolved into a quality management system, attuned to the power plant processes and built up to the international standard ISO 9001:2000. The certification took place in May 2003.

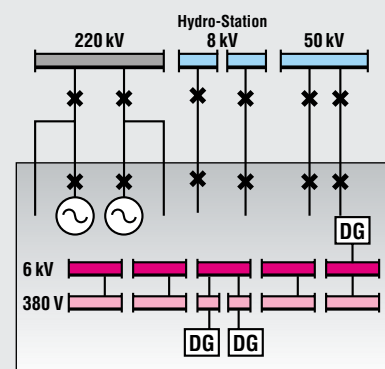
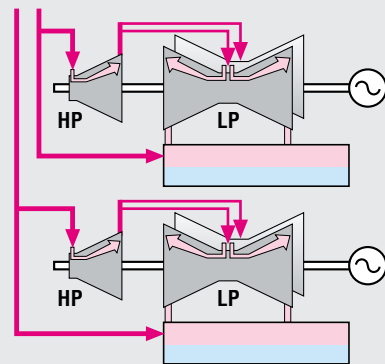
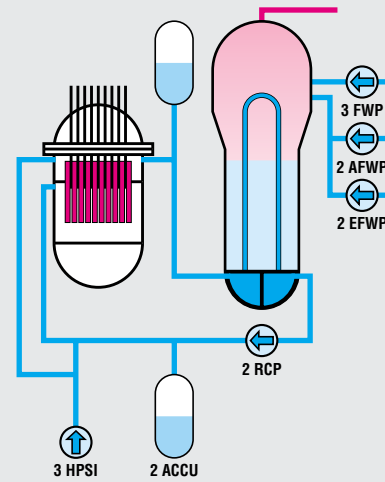
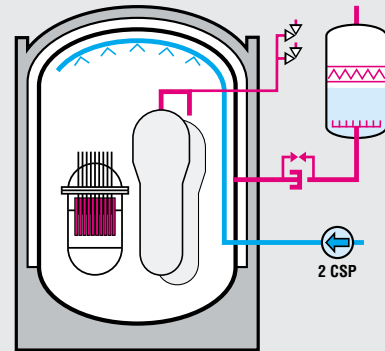
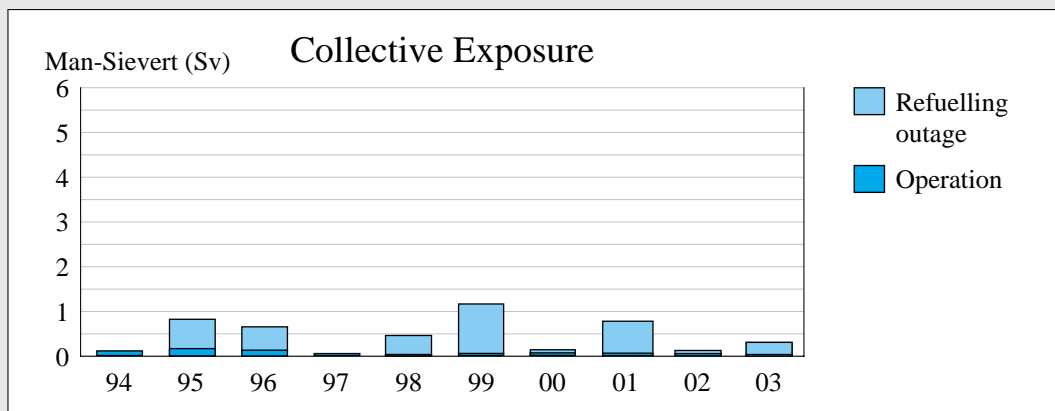
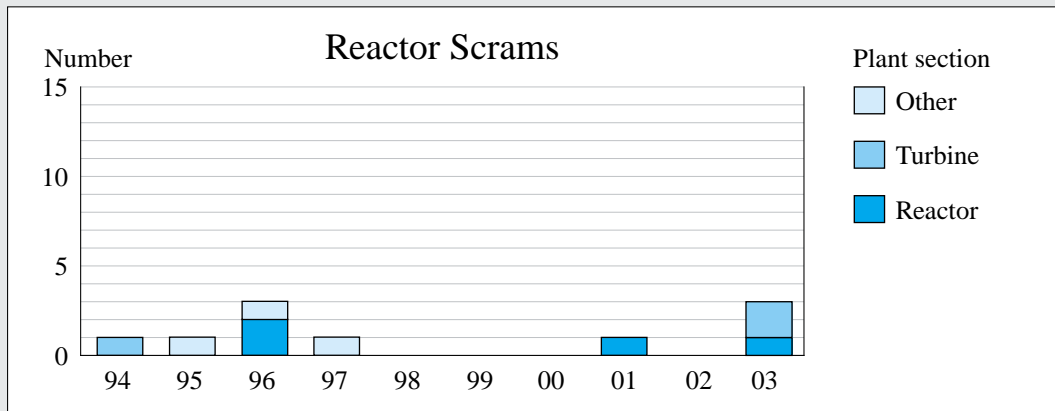
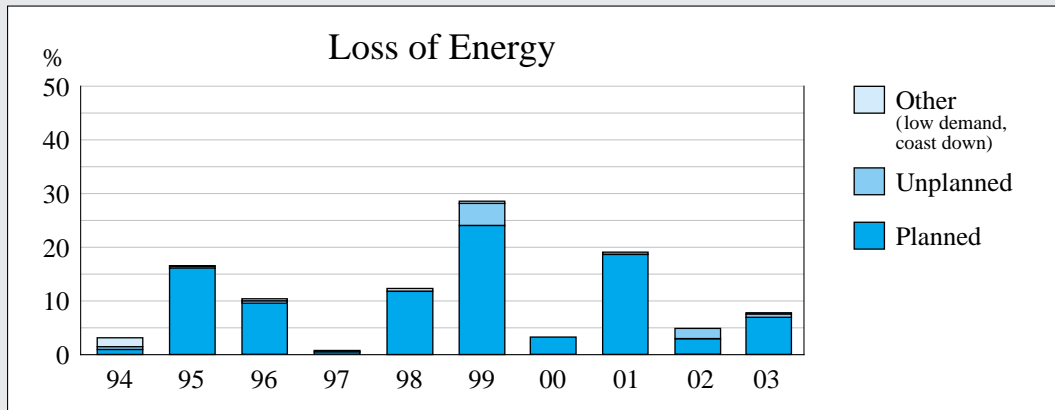
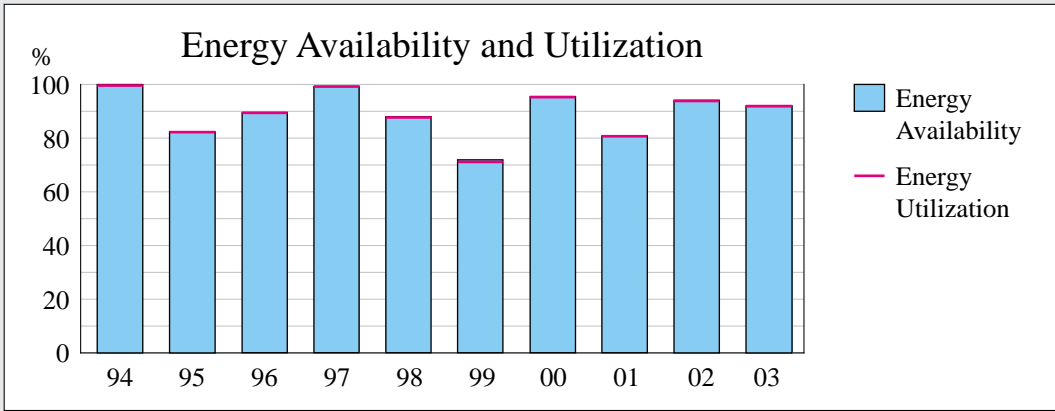
Important to Availability

June and July: The very hot summer had some effects on the power production, as the temperature of the cooling water outlet to the Aare River is limited to 32°C. Load had to be reduced several times on various days.

Refuelling outage July 25 to August 19: During the 25-day outage, 24 fuel elements of the total of 121 elements were replaced by new ones. 4 of the new elements contain reprocessed uranium. The concentration was on the inspection of the reactor pressure vessel head, focusing on the head penetrations for the control rod drive mechanisms and reactor instrumentation. The inspection produced good results. Other important tasks were the installation of new hydrogen recombiners, the inspection of a low-pressure turbine and the replacement of a station transformer.

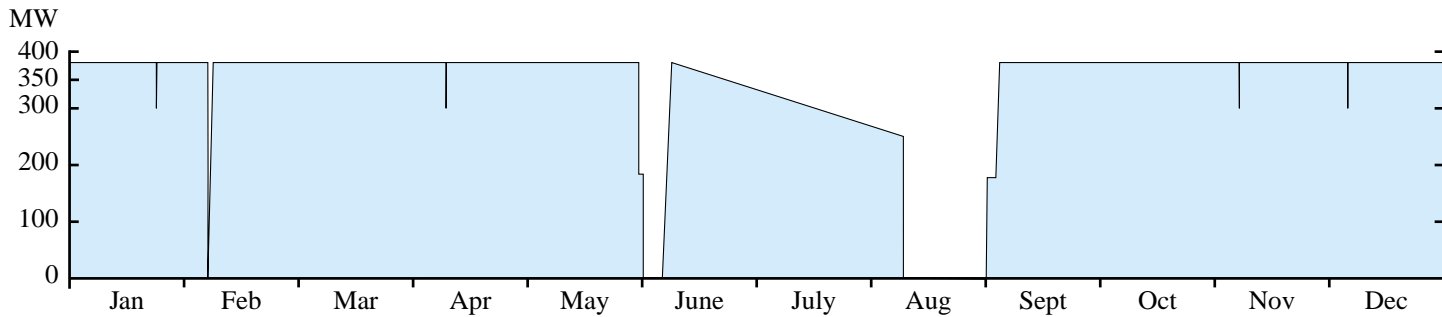
History

Characteristics



Mühleberg

Operating Experience 2003



Important to Safety

Scrams:

There were no automatic scrams during power operation.

Others:

February 6: Due to a leakage in an instrumentation housing in feedwater line A, the reactor was shut down to hot stand-by for repair.

Important to Availability

June 22: The planned coast-down operation began. The power at end of cycle reached 86.7%.

May 31 – June 7:

Planned cold shut-down of the plant to exchange a mechanical seal of recirculation pump B. At the same time a small leakage within the drywell was localised and repaired.

Refuelling outage August 10 to August 31:

The planned refuelling outage lasted 22 days. In-service inspections and ultrasonic tests of the reactor pressure vessel were successfully carried out. Also inspections of the core shroud were performed. One of the four built-in tie rods was inspected. 40 of 240 fuel elements were replaced.

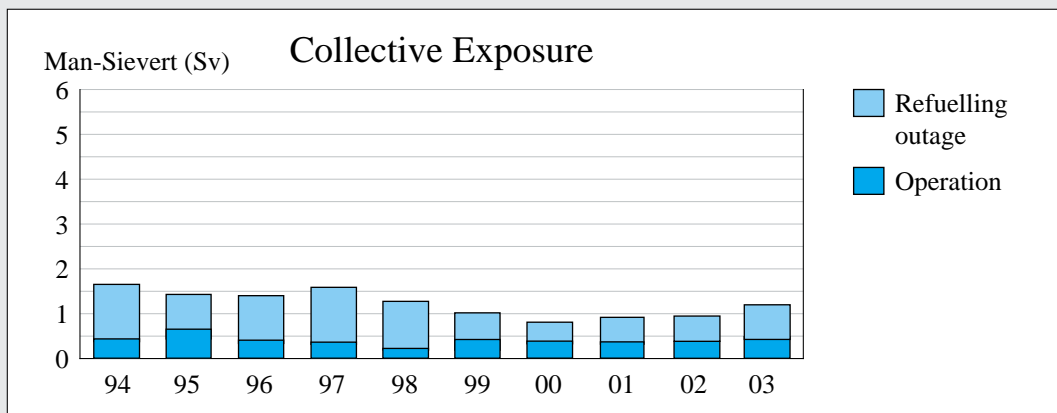
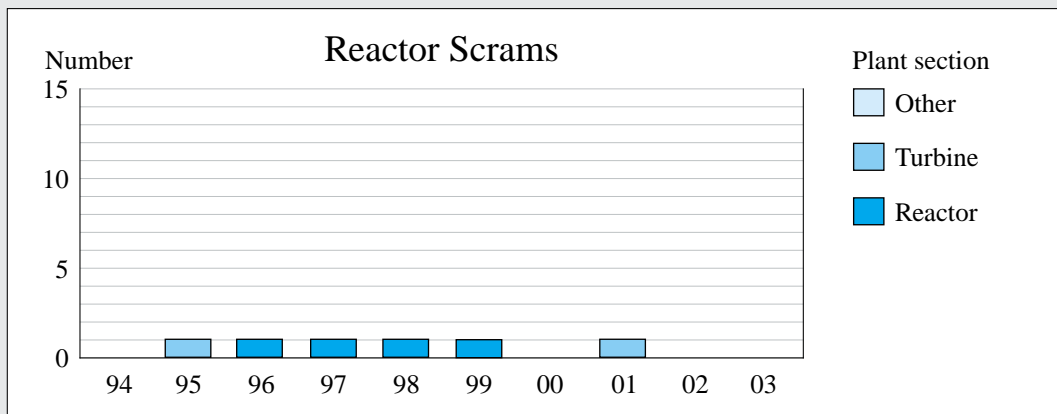
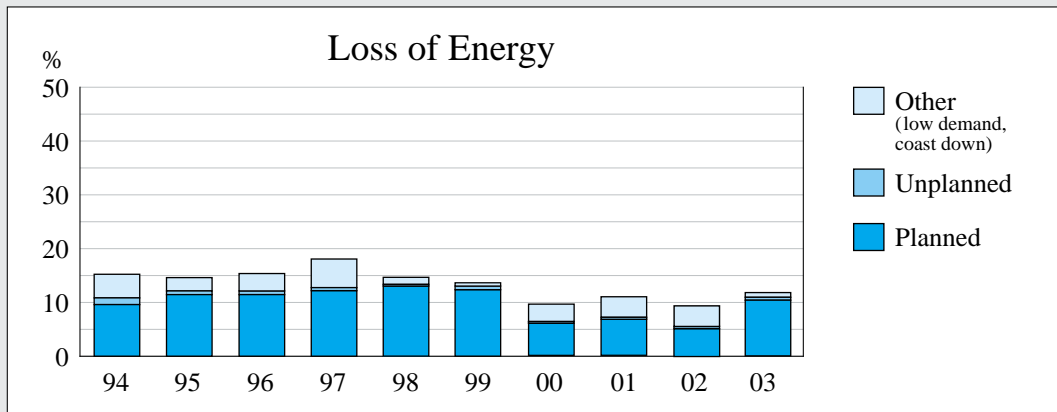
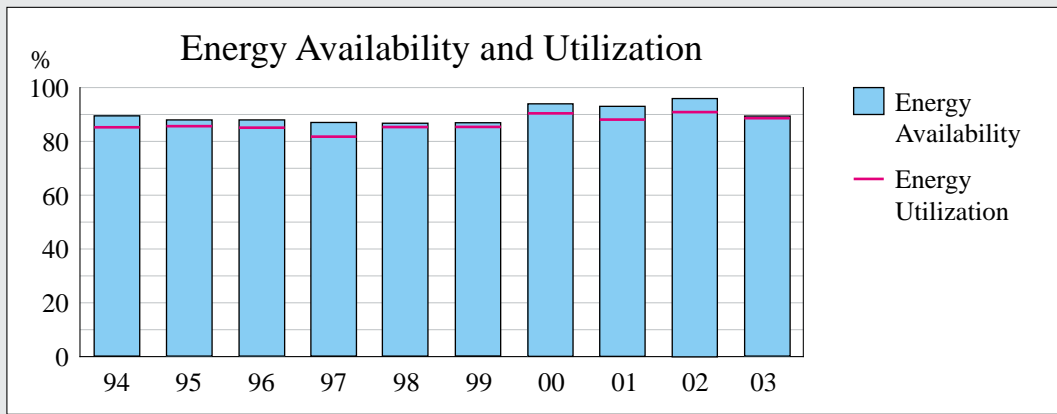
Load reductions:

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

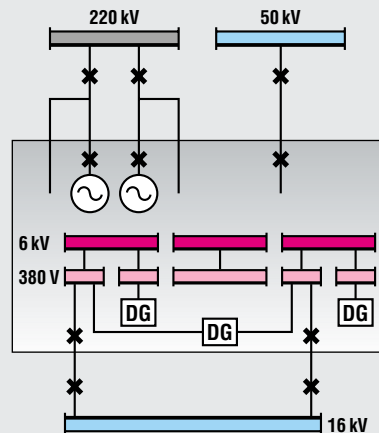
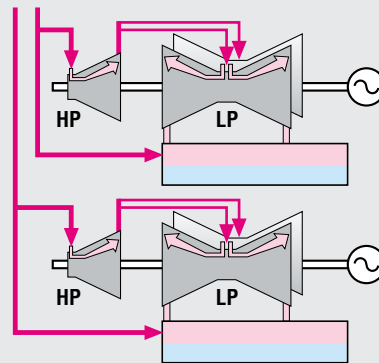
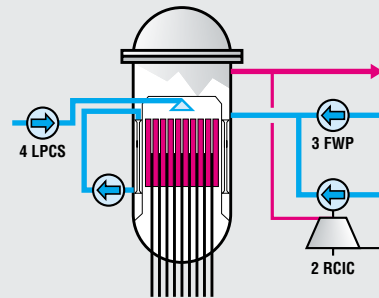
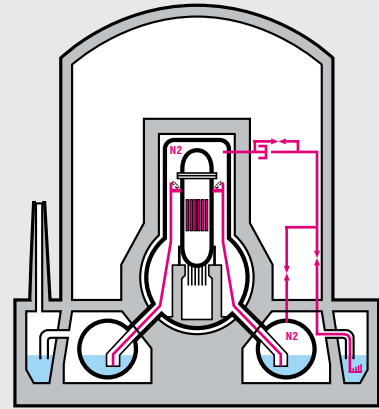
Four planned load reductions were required for periodic surveillance tests, combined with rod pattern adjustments and preventive maintenance.

From June 9 to August 10, an ongoing planned load reduction was made due to high temperature of the cooling water.

History

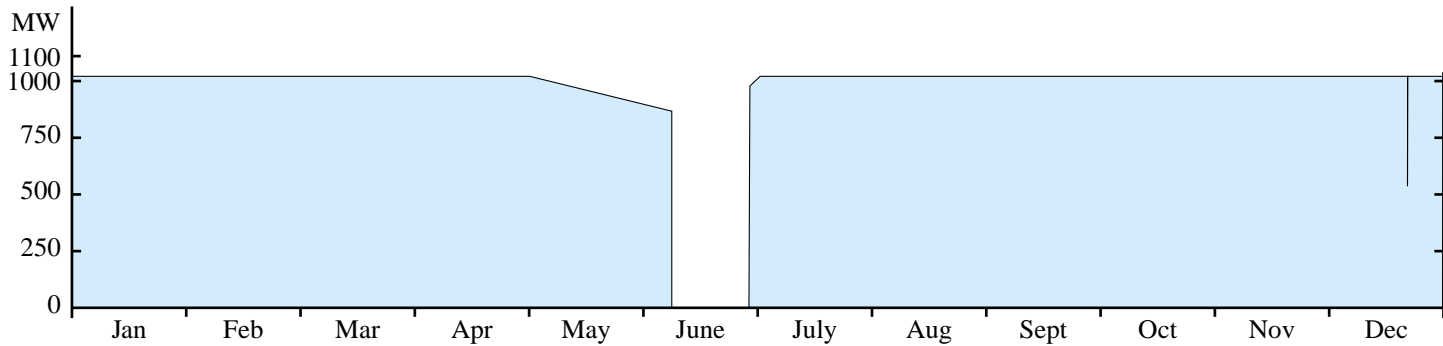


Characteristics



Gösgen

Operating Experience 2003



Important to Safety

Scrams:

2003 was the 13th consecutive year of operation without unplanned scrams.

Important to Availability

With a production of 8442 GWh, KKG achieved the best result since the start of operations.

April 29: Start of coastdown operation. The power level at the end of the cycle was 92%. Coastdown operation led to a production loss of about 2 equivalent full power days.

Refuelling outage June 8 to June 27:

The duration of the refuelling outage was 19.5 days, 0.5 days shorter than scheduled.

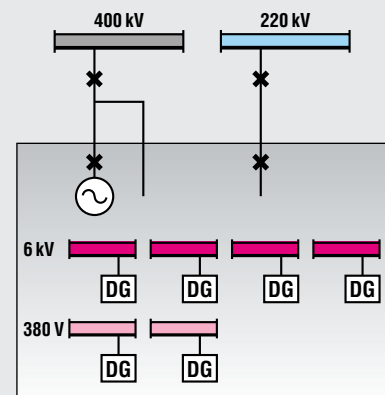
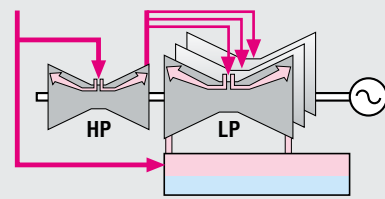
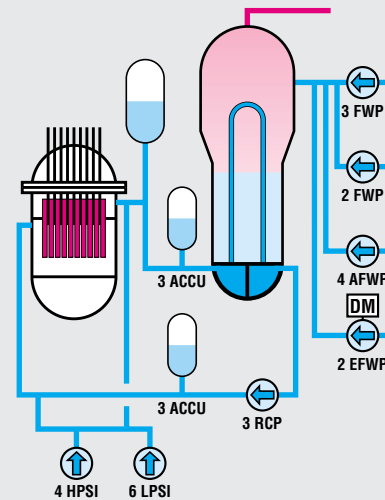
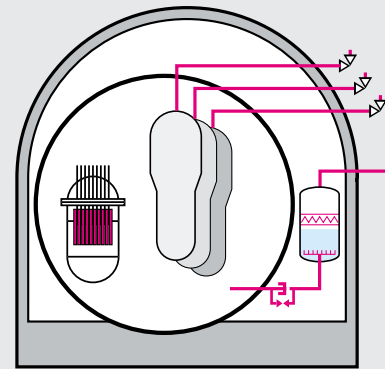
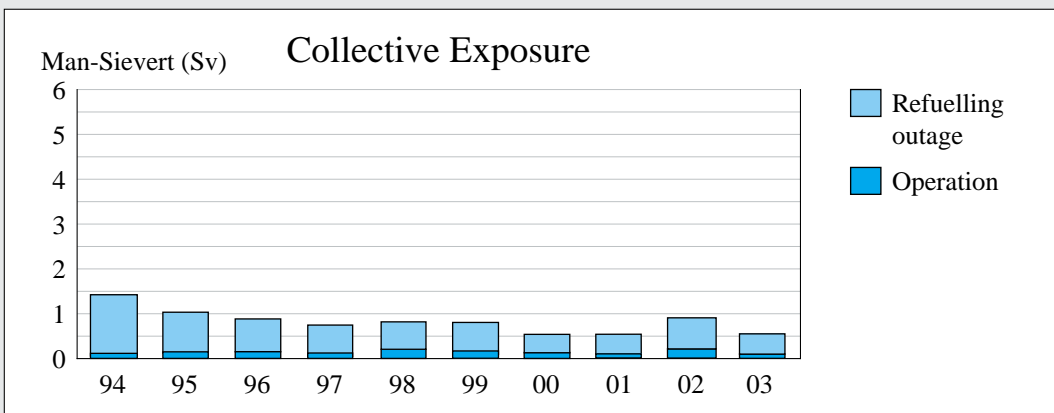
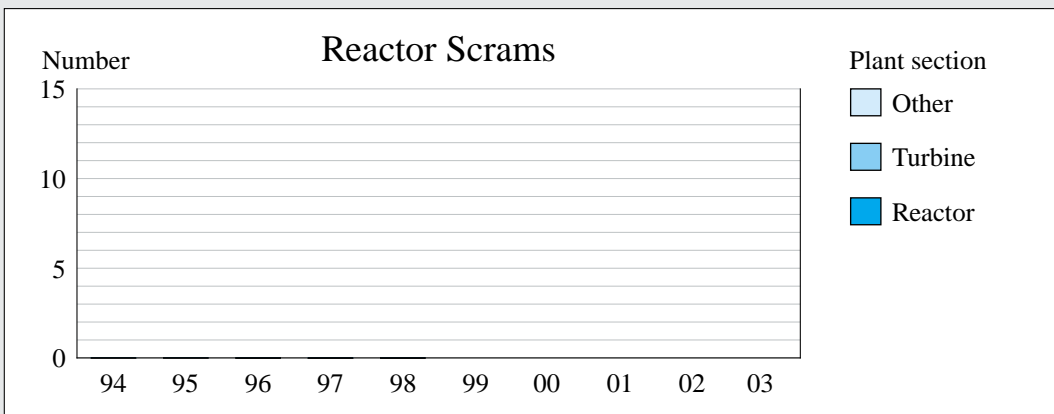
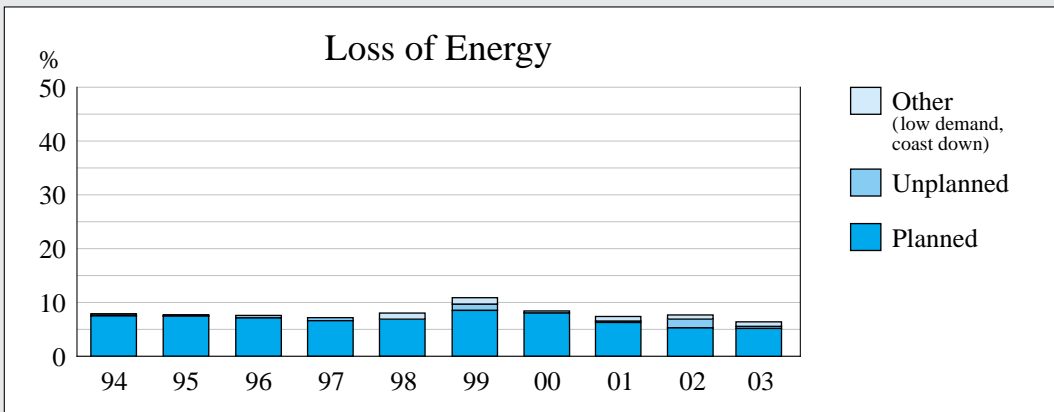
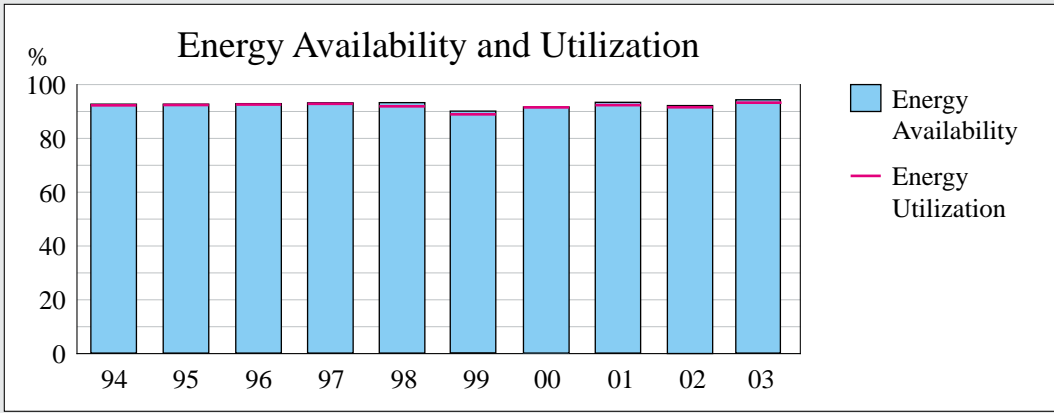
In addition to general preventive maintenance and inspection work, the following major work was performed:

- Major maintenance of a main condensate pump and an auxiliary condensate pump.
- Replacement of the shaft seal on a main coolant pump.
- Loading of 44 new fuel elements. The newly-loaded fuel included 24 MOX and 20 ERU fuel elements.
- Replacement of 70% of the water-distribution system of the cooling tower.
- Laser-scanning of the sealing grooves of the reactor vessel head and the sealing face of the reactor vessel.
- Replacement of the 27 kV generator circuit breaker against a new SF₆-breaker.

December 25: Unplanned load reduction due to an automatic signal from the control rod monitoring system.

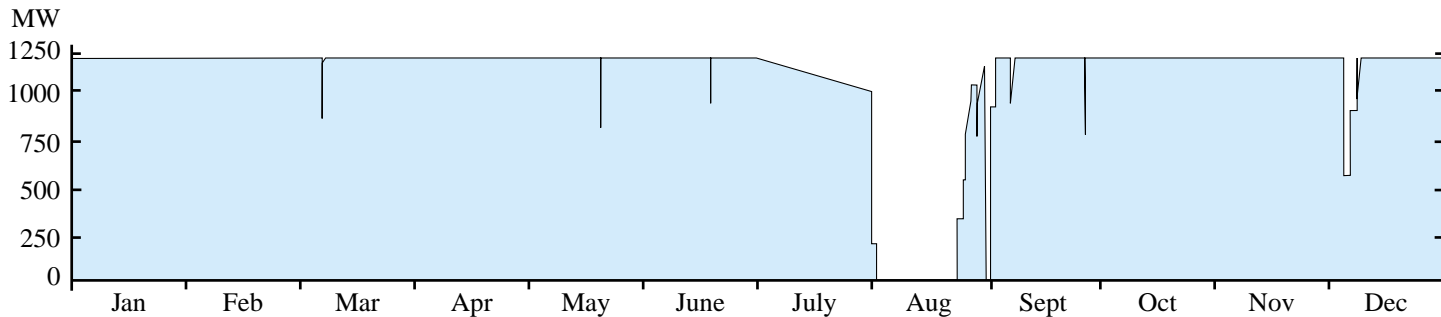
History

Characteristics



Leibstadt

Operating Experience 2003



Important to Safety

Scrams:

There were no automatic scrams during power operation.

Important to Availability

March 8: MSIV monitoring and control rod pattern adjustment.

May 31: MSIV monitoring and control rod pattern adjustment.

June 22: Control rod pattern adjustment.

July 7: Start end-of-cycle coast-down.

August 2–25: 19th refuelling outage

Duration was 22.2 days (scheduled 22.3). Loaded 132 new fuel bundles and 3 re-inserts (out of 648).

August 29: Control rod pattern adjustment.

August 31: Plant shutdown to repair instrument air leak in the Drywell.

September 6: Control rod pattern adjustment.

September 28: Grid disturbance (Blackout in Italy), MSIV monitoring, and control rod pattern adjustment.

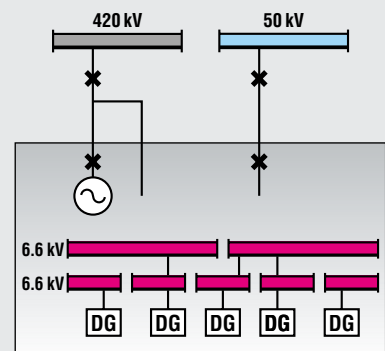
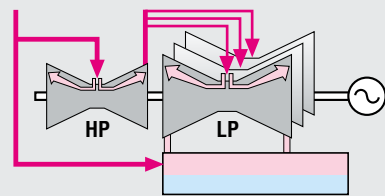
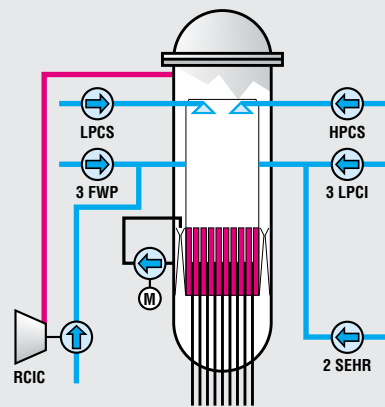
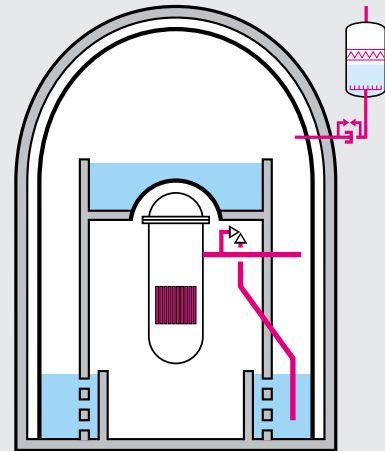
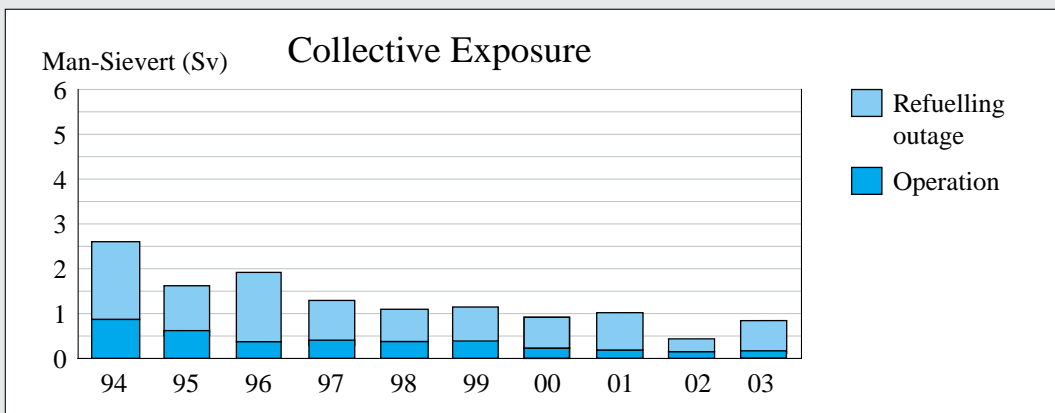
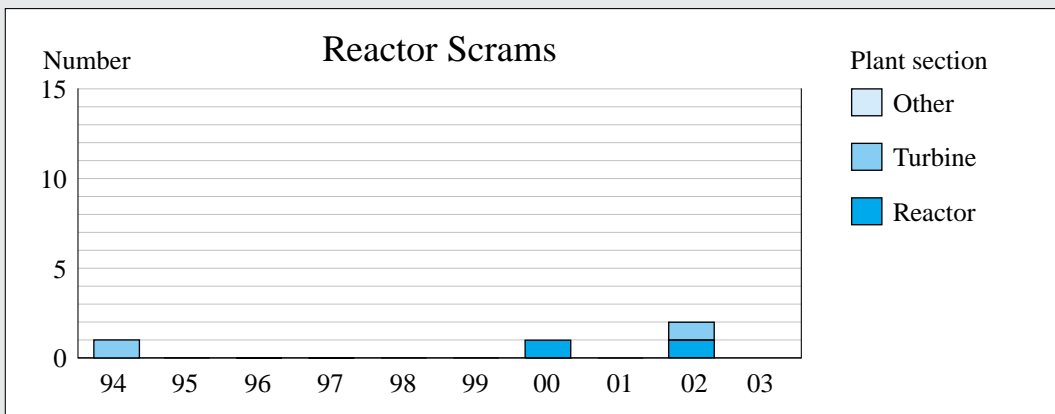
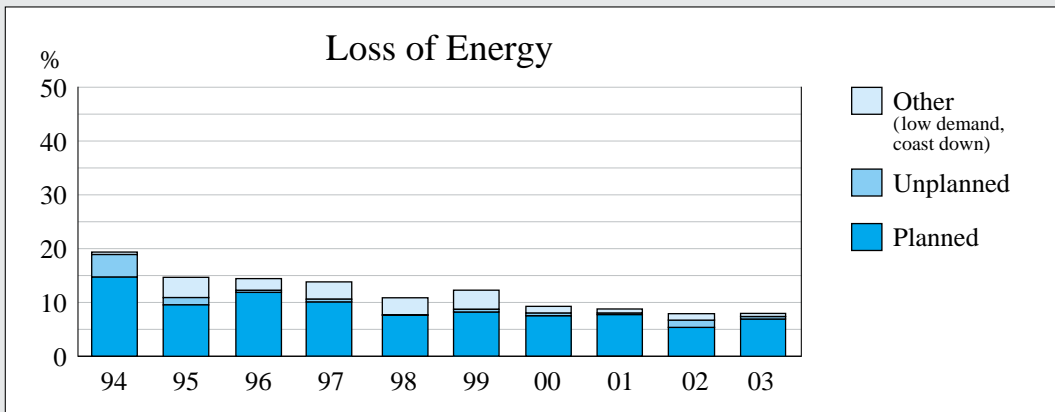
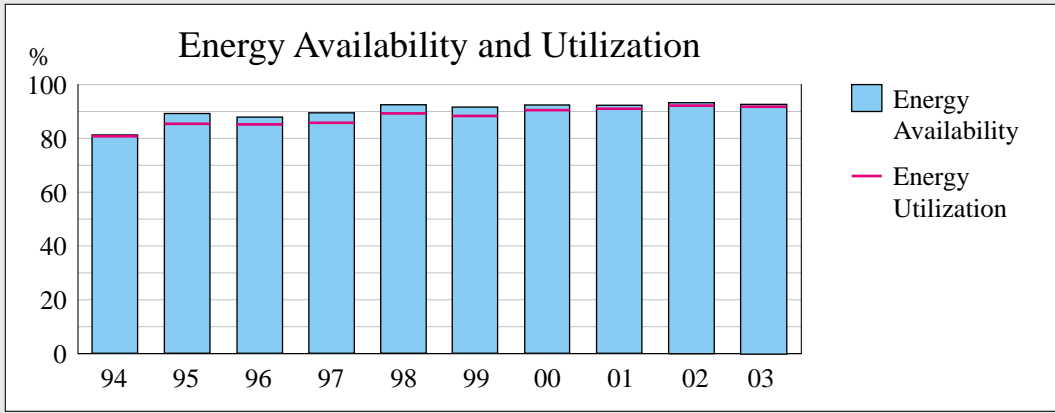
December 6: Repair Feedwater Pump Motor.

December 7: MSIV monitoring.

December 8: 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%)

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