

Summary of

Operating Experience

in Swiss Nuclear Power Plants

2007

DEFINITIONS

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

Energy Availability

Potential energy production assuming available capacity during a specific period

$$\text{Energy Availability Factor} = \frac{\text{Energy Availability}}{\text{Production Potential}}$$

Energy Utilization

Energy actually produced within a specific period

$$\text{Energy Utilization Factor} = \frac{\text{Energy Utilization}}{\text{Production Potential}}$$

Production Potential

Potential energy production assuming maximum capacity continuously available throughout a specific period

Production Potential (100%)

- Loss of energy production (unplanned)
- Loss of energy production (planned)

$$= \text{Energy Availability}$$

- Coast Down
- Low power demand

$$= \text{Energy Utilization (Capacity)}$$

SWISS NUCLEAR POWER PLANTS

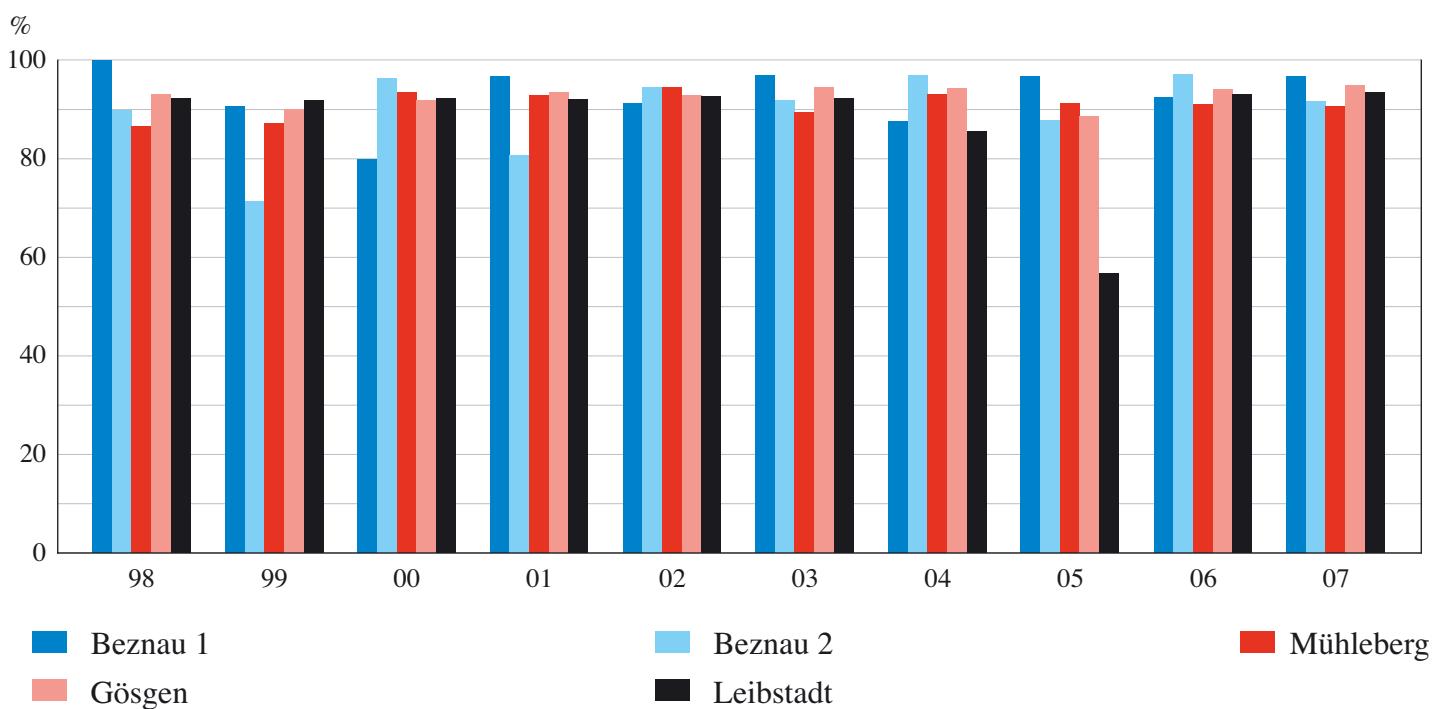
Power station	Type of reactor	Net output (MWe)	Commercial operation
Beznau (KKB)	PWR	365	Unit 1: Dec. 24, 1969
		365	Unit 2: Mar. 15, 1972
Mühleberg (KKM)	BWR	355	Nov. 6, 1972
Gösgen (KKG)	PWR	970	Nov. 19, 1979
Leibstadt (KKL)	BWR	1165	Dec. 15, 1984



Swiss Nuclear Power Plants: Production Figures 2007 and History

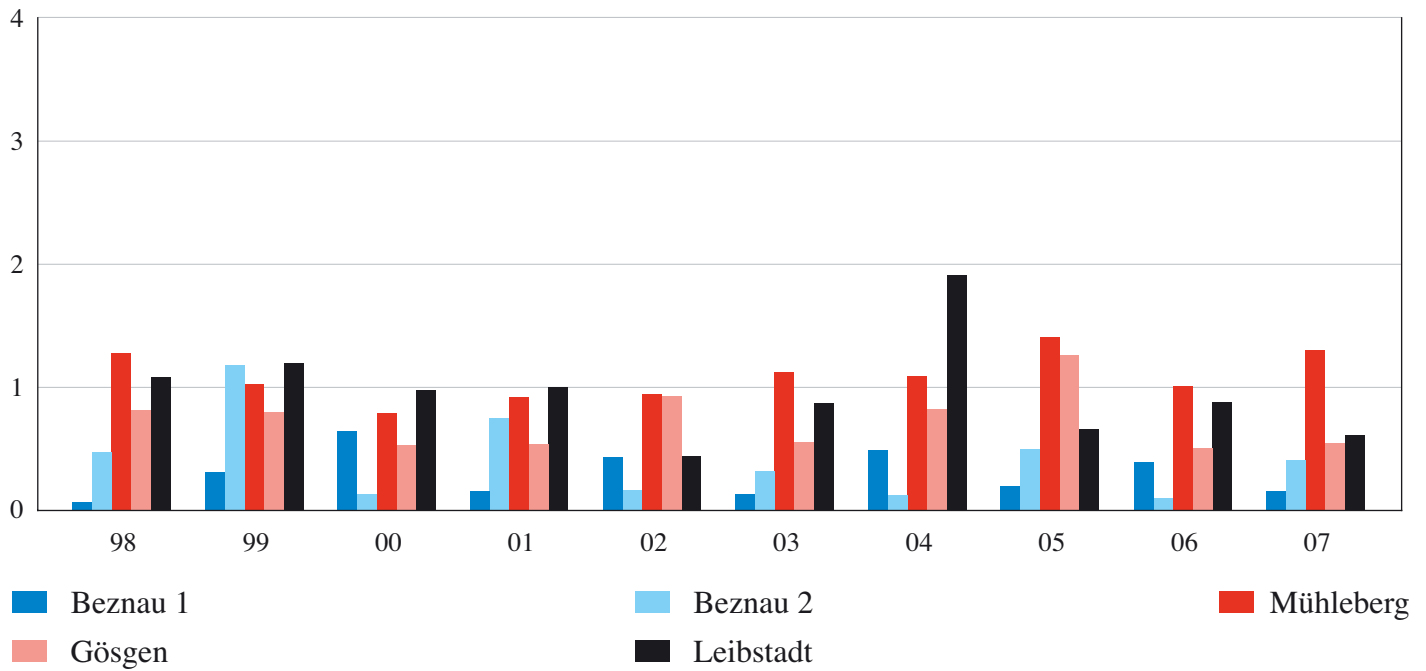
	Gross production MWh	Net production MWh	Total operating time (power production) h	Total gross production since start of operation MWh	Total net production since start of operation MWh
KKB 1	3 211 841	3 081 344	8486	102 734 201	98 314 072
KKB 2	3 034 465	2 911 647	8063	101 935 344	97 691 060
KKM	3 010 400	2 896 965	8021	93 838 405	89 698 218
KKG	8 602 966	8 158 909	8313	222 099 924	209 692 077
KKL	9 912 102	9 436 801	8277	193 507 609	183 527 915

Energy Availability



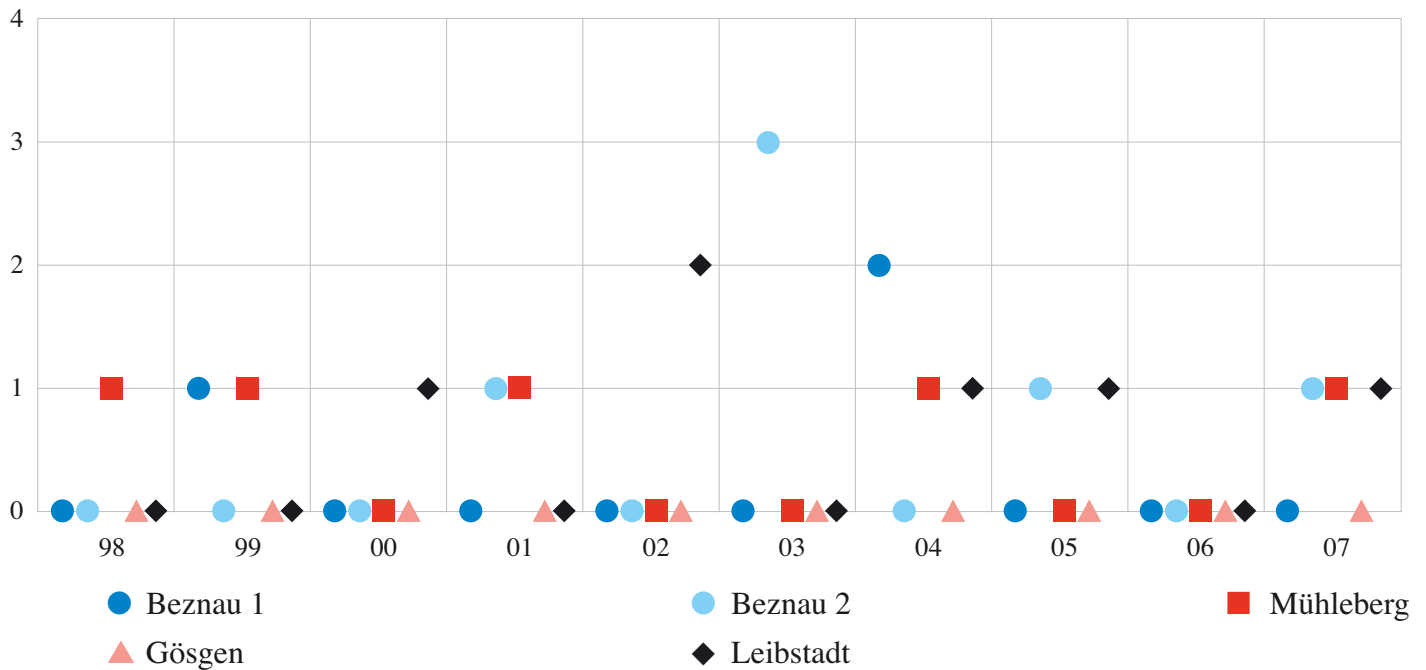
Collective Exposure

Man-Sievert (Sv)



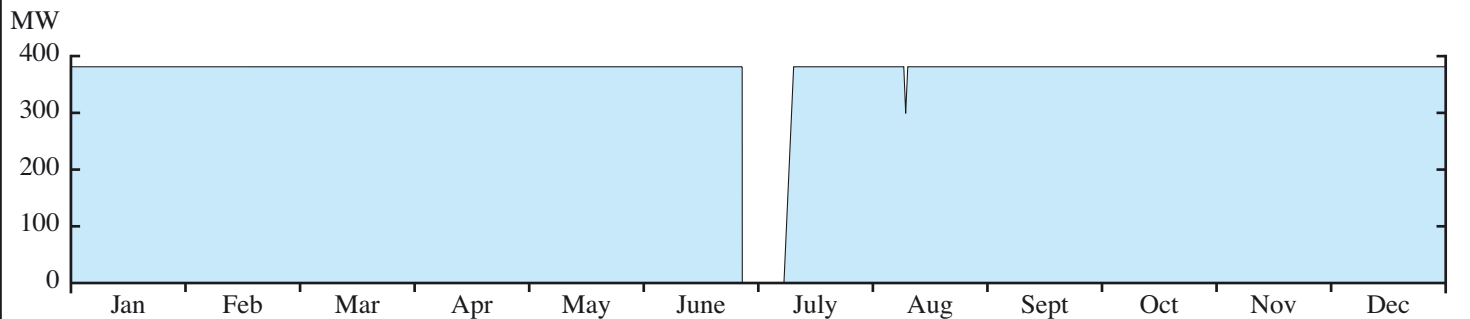
Reactor Scrams

Number



Beznau 1

Operating Experience 2007



Important to Safety

Scrams:

There were no automatic scrams during power operation.

Other:

On April 4 the new Beznau training simulator was taken over from the Canadian manufacturer, thus finishing a three year period of design and development. The «Ready for Training» means that Beznau now disposes of a modern full-scale simulator, for the continuing education of the licensed operating personnel and the introduction of junior staff members. In previous years, the simulator training had taken place abroad.

Important to Availability

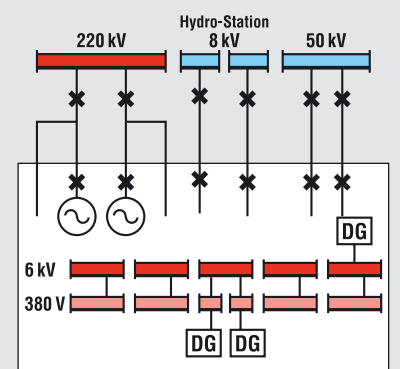
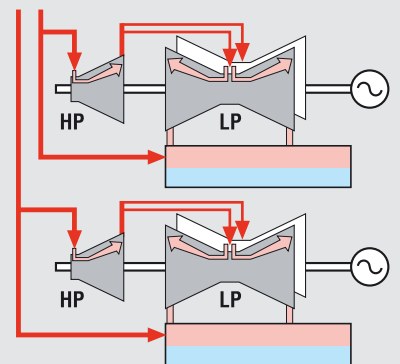
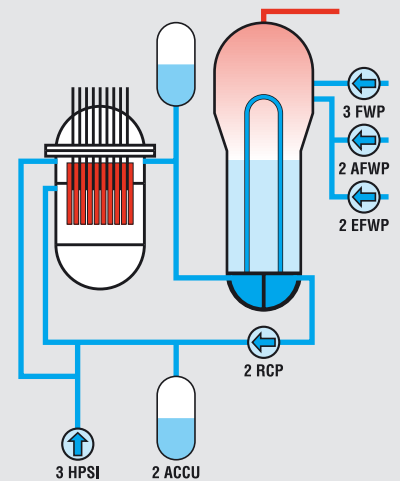
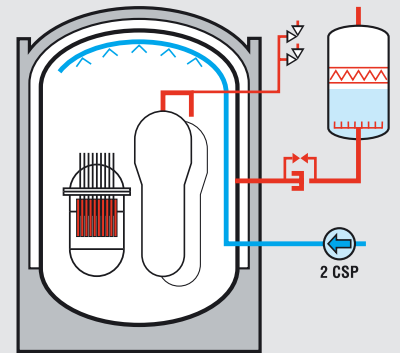
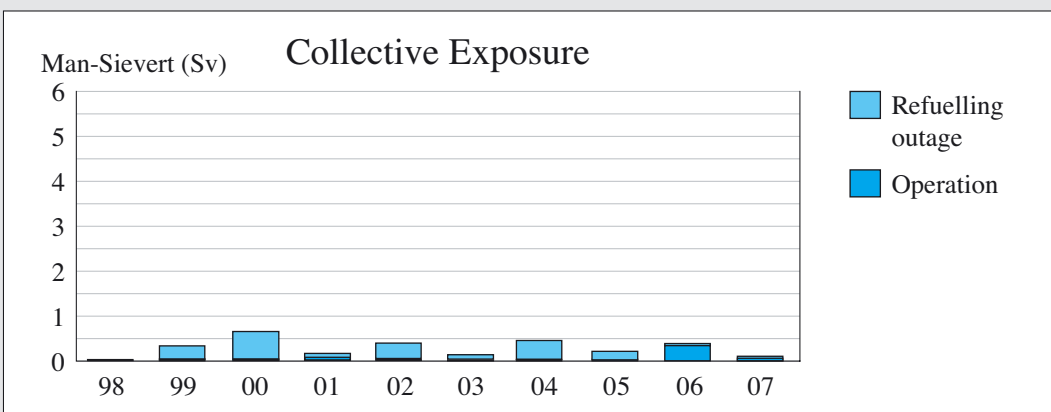
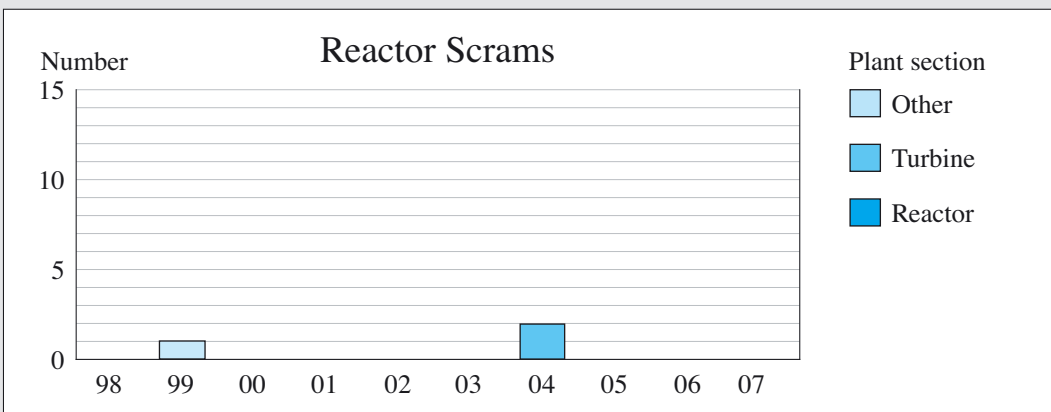
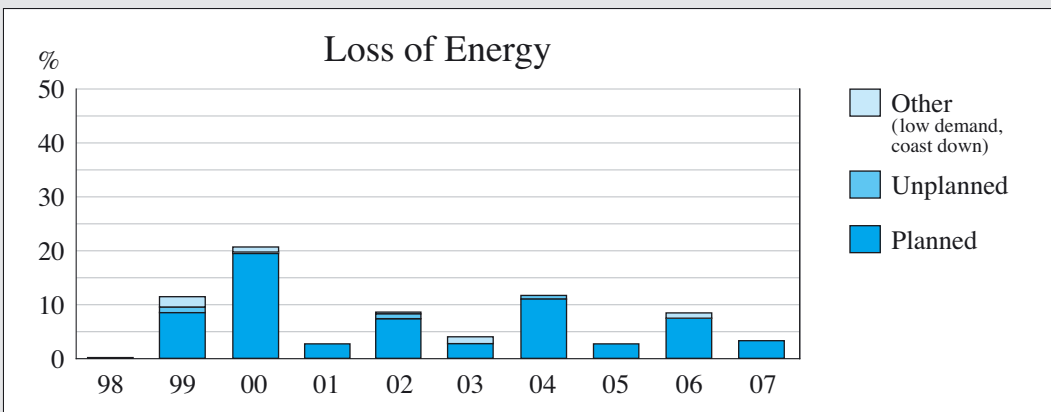
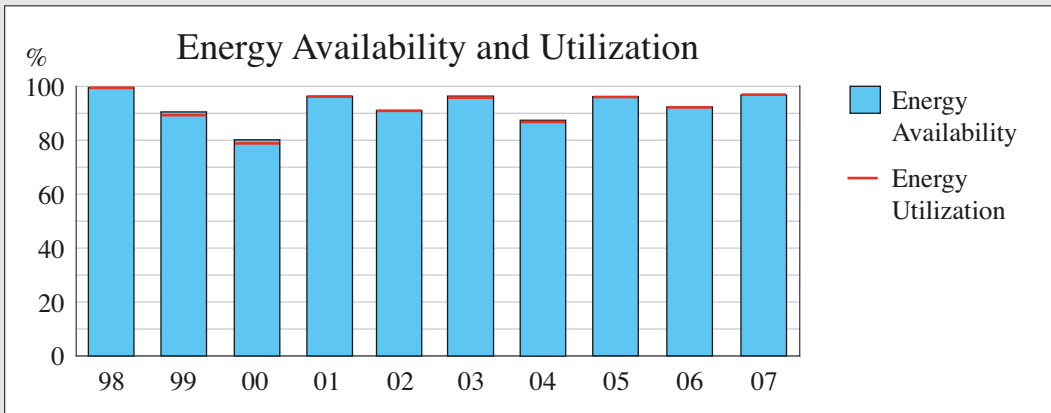
June 26 to July 7: The planned 35th refuelling outage lasted 11 days and served to replace 24 from a total of 121 fuel elements. 16 of the new elements contain reprocessed uranium and 8 are MOX elements. All inspections showed the plant and machinery in good condition.

August 9: Floodwater in the river Aare, due to intensive rainfall, led to a reduced intake flow through the condensers of both turbogenerators and therefore to load reduction.

Net Production	3081 344 MWh
Energy Availability	96,7 %
Energy Utilization	96,7 %

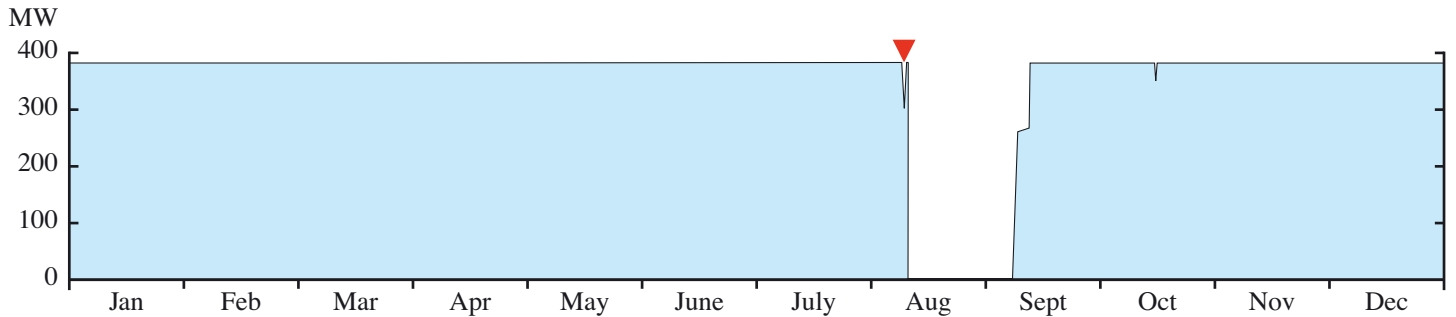
History

Characteristics



Beznau 2

Operating Experience 2007



Important to Safety

Scrams:

On August 10, there was an automatic scram at a thermal reactor capacity of 12% during the planned shutdown for the refuelling outage. At this phase, the water level on the secondary side of the steam generators tends to fluctuate. Its control calls for interventions by the reactor operator. In this case, the operator did not succeed in limiting the fluctuations sufficiently.

Other:

On April 4, the new Beznau training simulator was taken over from the Canadian manufacturer, thus finishing a three year period of design and development. The «Ready for Training» means that Beznau now disposes of a modern full-scale simulator for the continuing education of the licensed operating personnel and for the introduction of junior staff members. In previous years, the simulator training had taken place abroad.

Important to Availability

August 9: Floodwater in the river Aare, due to intensive rainfall, led to a reduced intake flow through the condensers of both turbogenerators and therefore to load reduction.

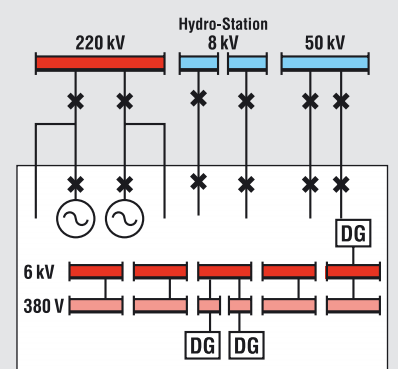
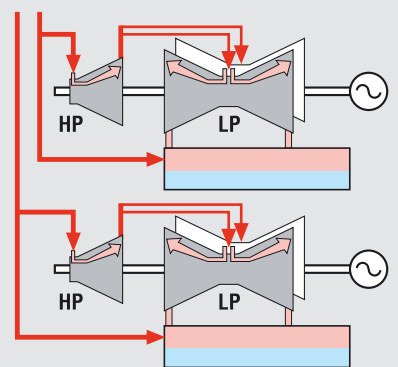
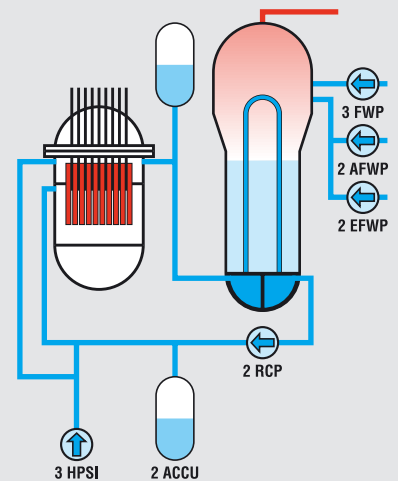
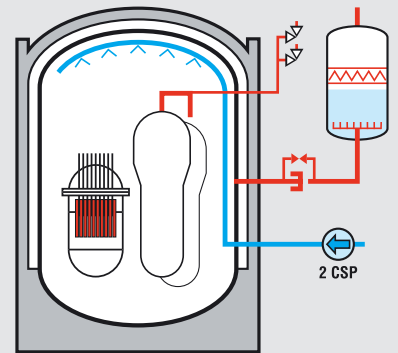
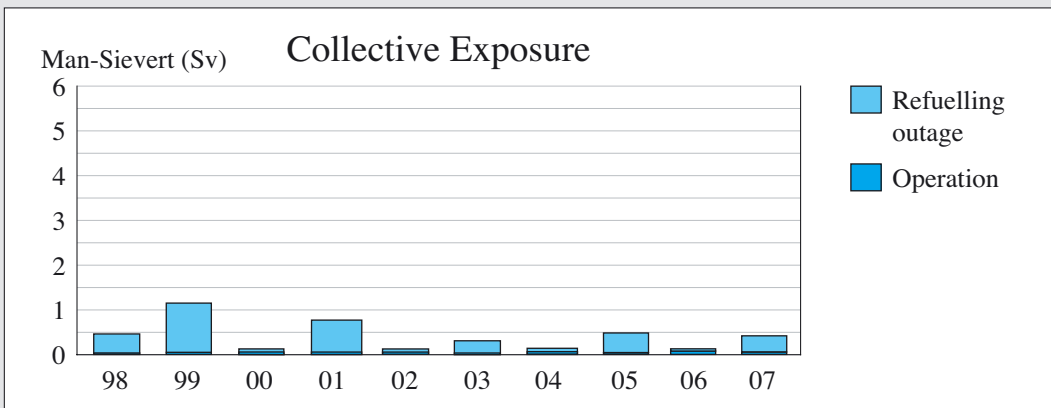
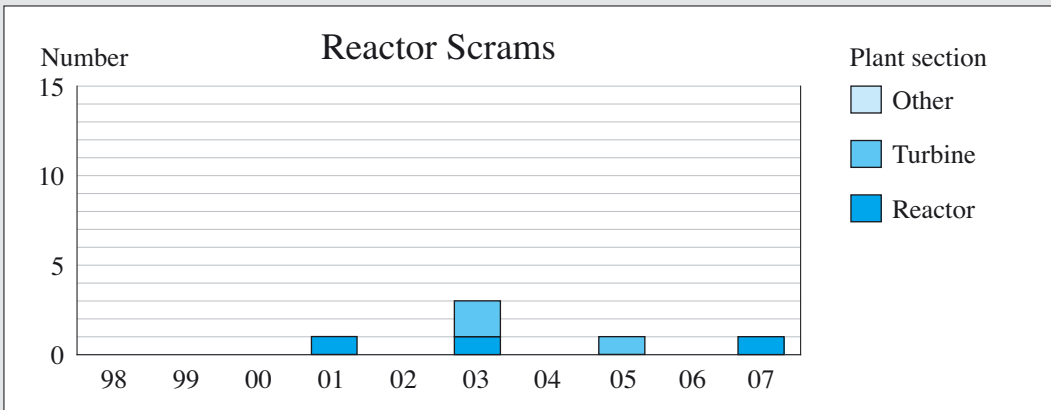
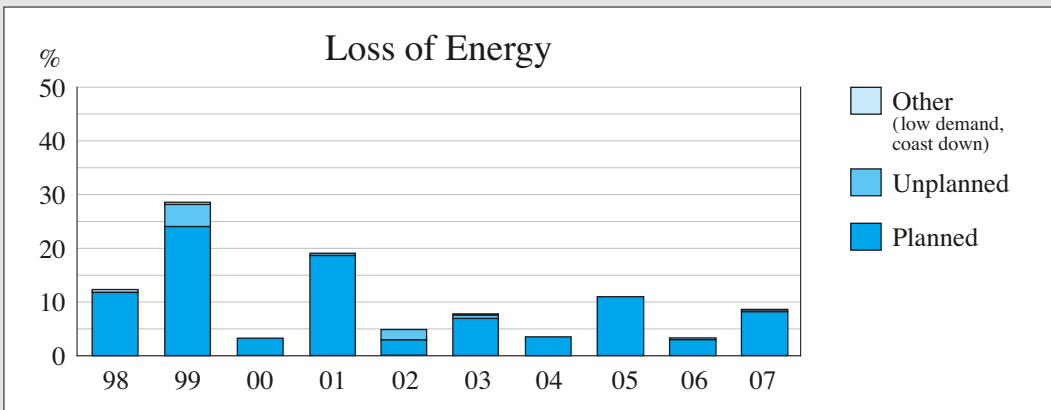
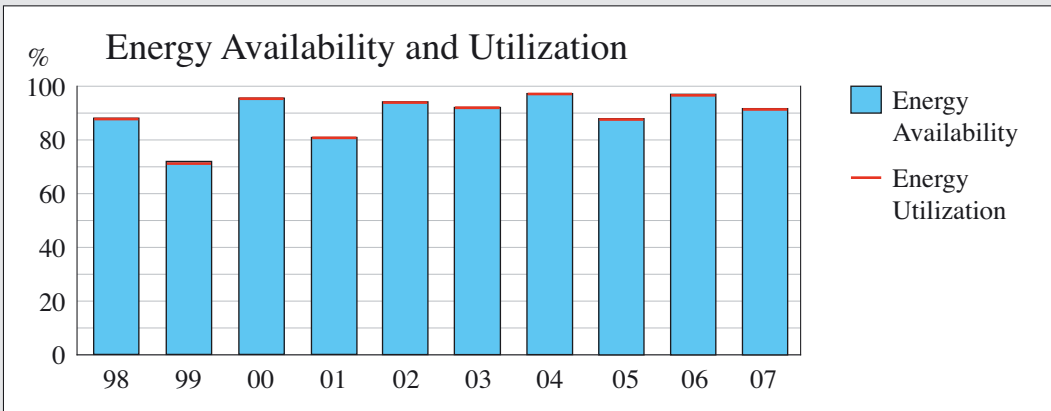
August 10 to September 7: The planned 33rd refuelling outage lasted 29 days and served to replace one sixth from a total of 121 fuel elements. The 20 new elements contain reprocessed uranium. Key activities of the revision were the inspection of the main components of the nuclear part of the power plant. For the inspection of the welding seams on the penetrations through the head of the reactor pressure vessel by means of eddy current and ultra sound, qualified methods were used. All inspections and examinations showed the plant and machinery in good condition.

October 15: Shut down of water separator/reheater of turbogroup 1 for the repair of a steam leak from a measuring flange.

Net Production	2911 647 MWh
Energy Availability	91,7 %
Energy Utilization	91,4 %

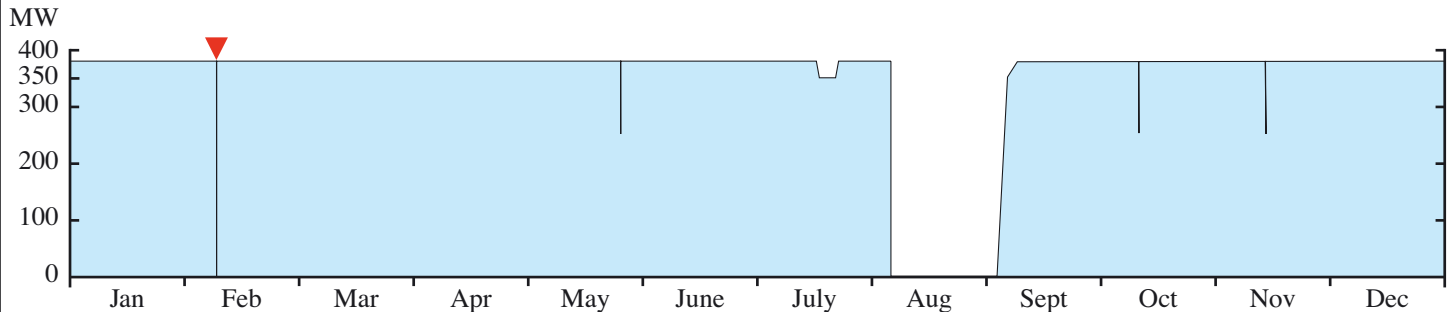
History

Characteristics



Mühleberg

Operating Experience 2007



Important to Safety

Scrams:

There was one automatic scram during power operation.

February 8: During commissioning of a condensate filter unit a scram and main steam isolation occurred due to high main steam activity. A small amount of a chemical compound needed in the manufacturing of the filter units was released to the reactor and subsequently caused a short release of N16 and thus the isolation.

Other:

From January 18 to 27 an on-line noble metal chemical application was performed to protect reactor pressure vessel internals.

Important to Availability

Refueling outage August 5 to September 3: The planned refueling outage lasted 30 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. On turbine B the high pressure turbine was modified and the low pressure turbines were replaced. Also on train B a new main cooling water pump with a speed variable motor was installed. An emergency diesel generator was replaced. 40 out of 240 fuel elements were replaced.

Load reductions:

A total of 4 load reductions (> one full power hour) occurred.

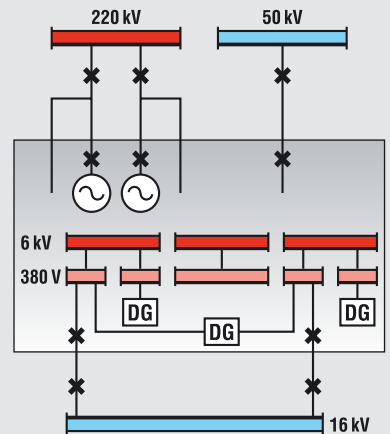
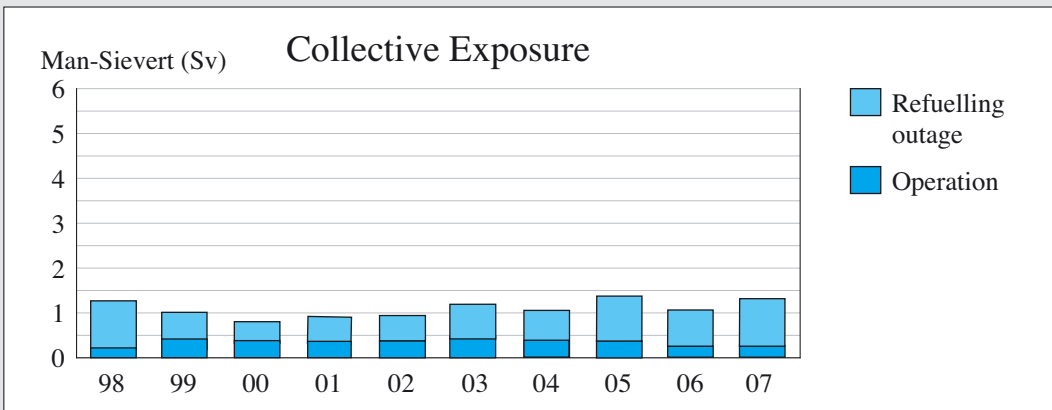
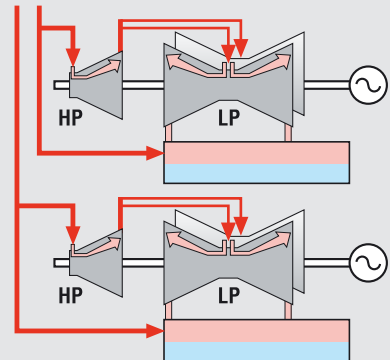
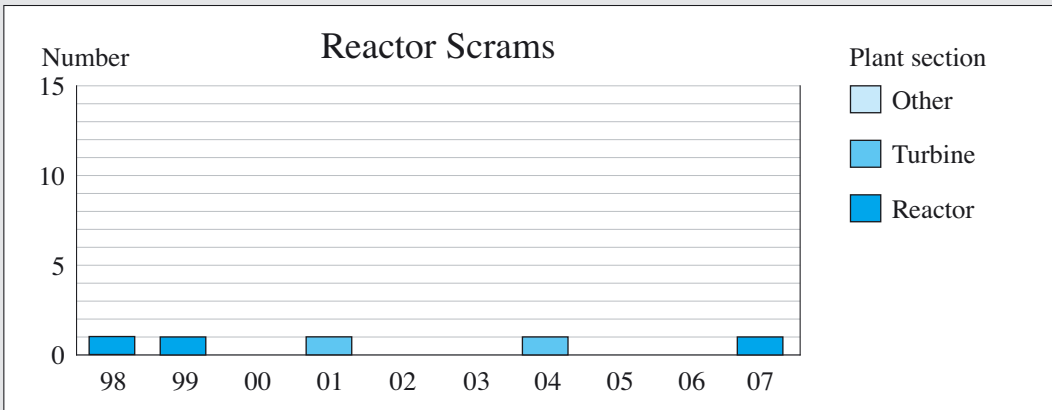
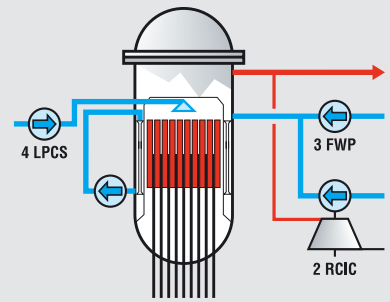
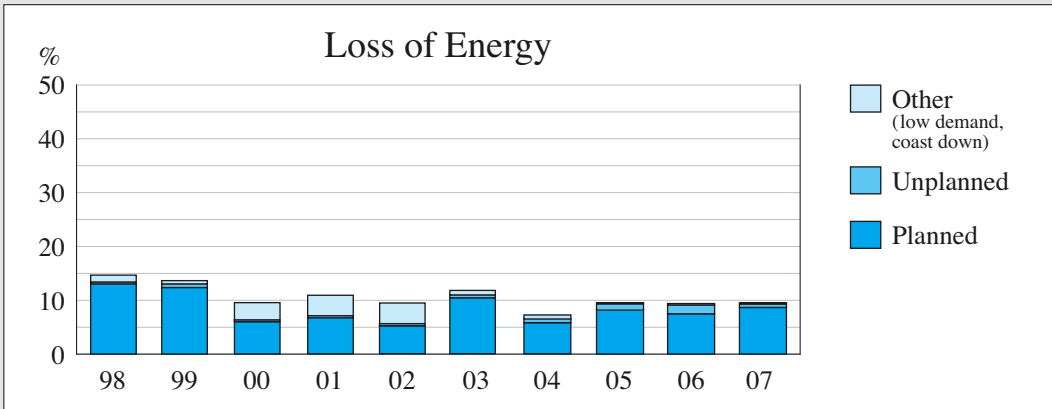
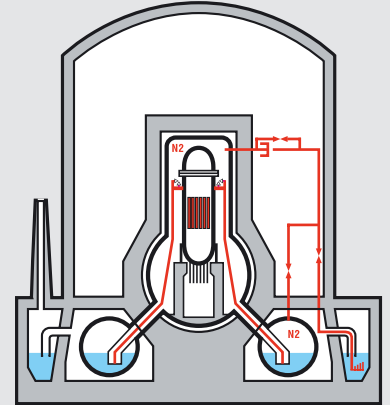
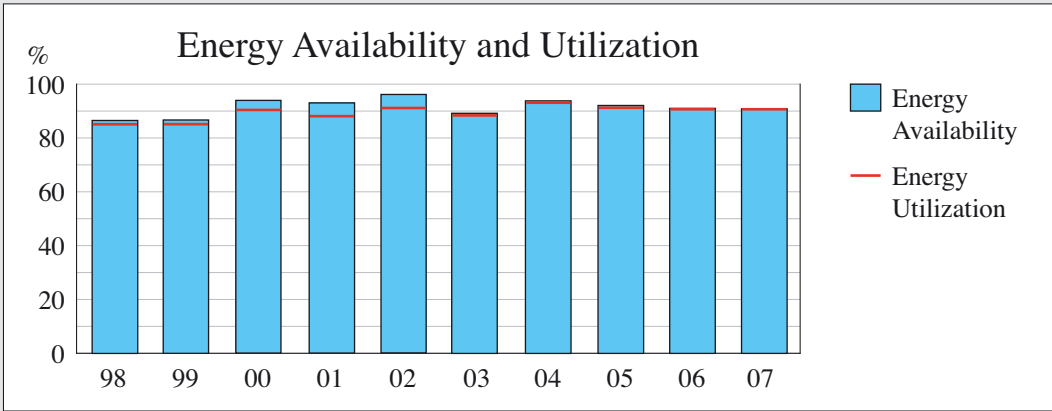
Three planned load reductions were required for periodic surveillance tests, combined with rod pattern adjustments and preventive maintenance.

From July 16 to 22 one planned load reductions was made due to high temperature of the cooling water.

Net Production	2 896 965 MWh
Energy Availability	90,7 %
Energy Utilization	90,6 %

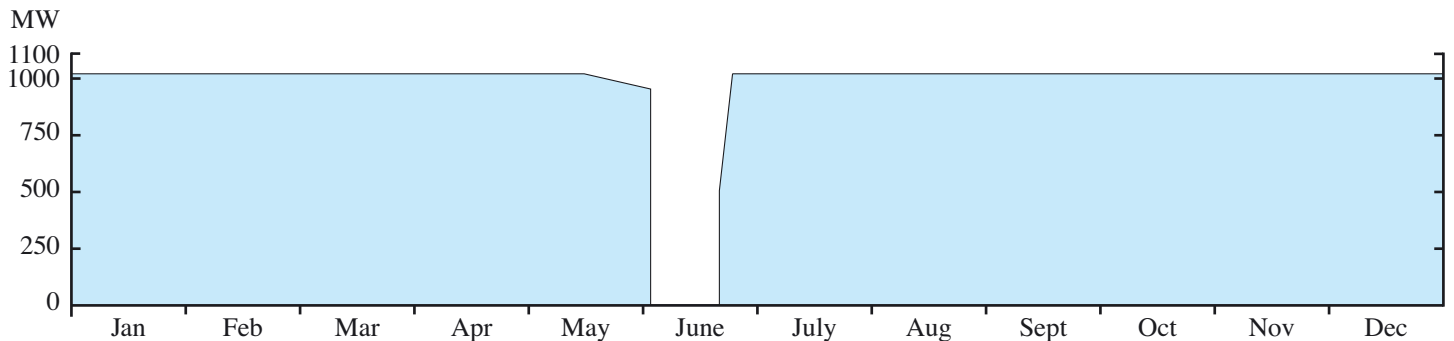
History

Characteristics



Gösgen

Operating Experience 2007



Important to Safety

Scrams:

2007 was the 17th consecutive year of operation without unplanned scrams.

Important to Availability

With a production of 8603 GWh, KKG has reached the best result since start of operation.

May 15: Start of coast down operation. The power level at the end of the cycle was 96 %. Coast down operation led to a production loss of about ½ equivalent full power day.

Refuelling outage, June 02 to June 20:

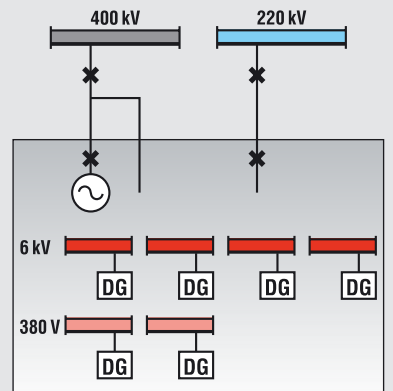
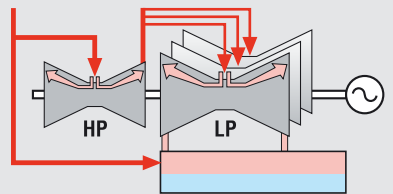
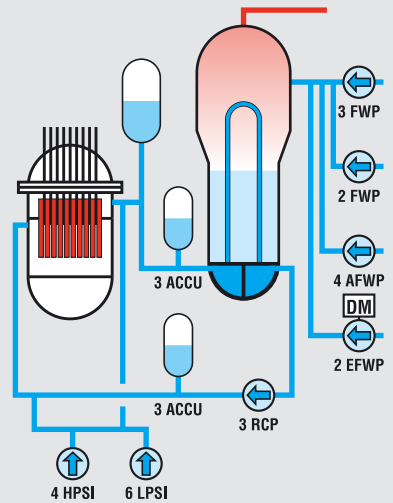
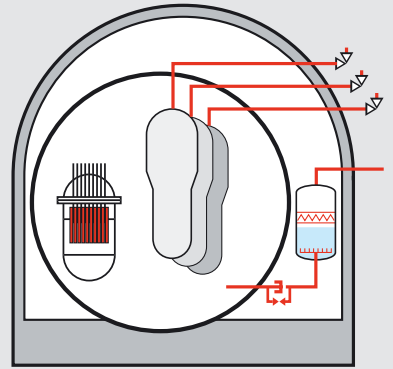
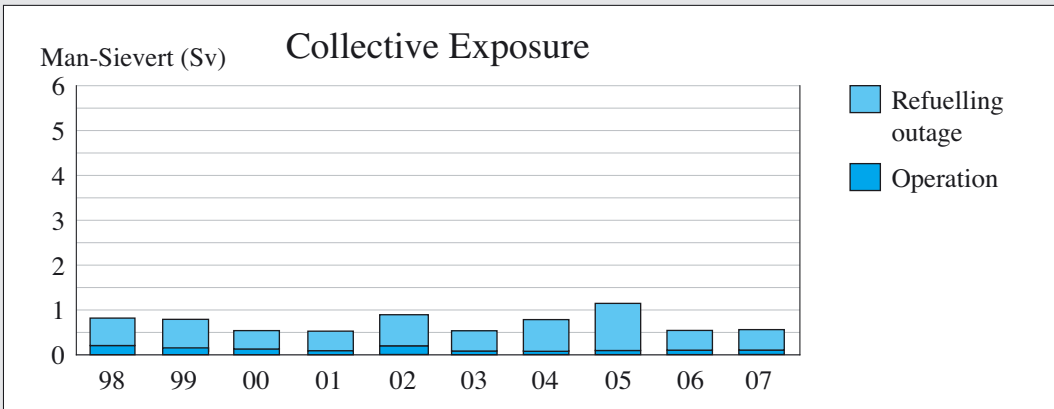
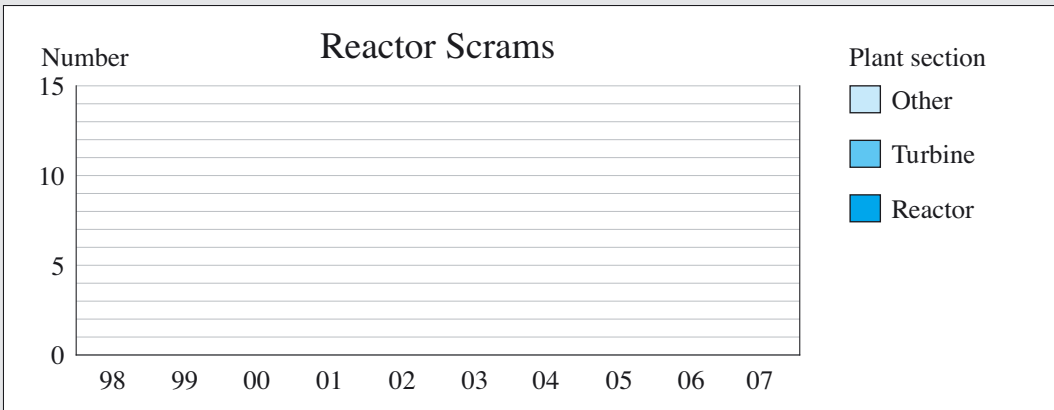
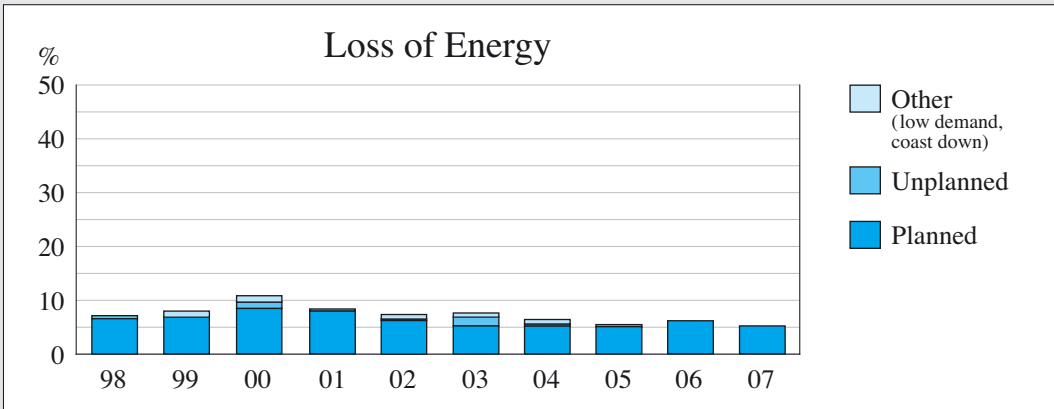
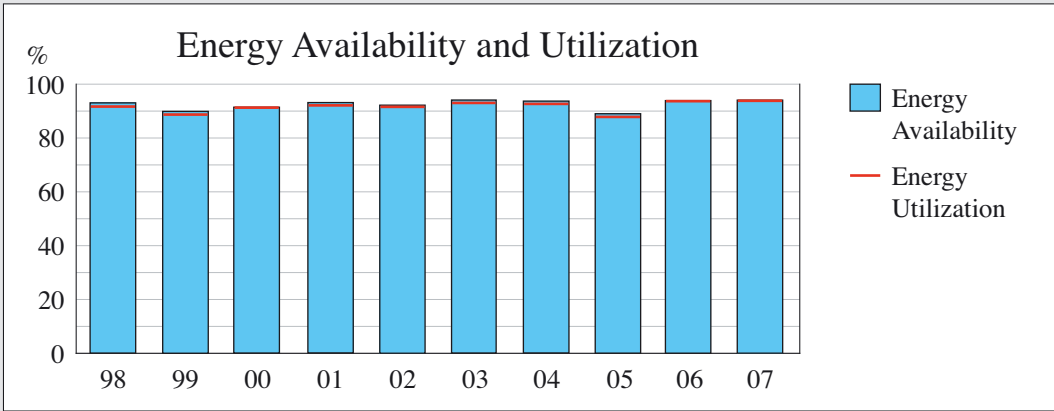
The duration of the refuelling outage was 18 days. In addition to general preventive maintenance and inspection work, the following major work was performed:

- Welding seam surface inspection of the pipes of the primary coolant system
- Loading of 44 new fuel elements (24 ERU elements). 20 new MOX fuel elements were loaded for the 29th cycle
- Exchange of the sump-strainer of the residual heat removal system
- Exchange of all feedwater main-control-valves
- Main maintenance of a low pressure turbine
- Exchange of an auxiliary transformer
- Replacement of the automatic control of the shaft seal system by a digital system

Net Production	8 158 909 MWh
Energy Availability	94,9 %
Energy Utilization	94,7 %

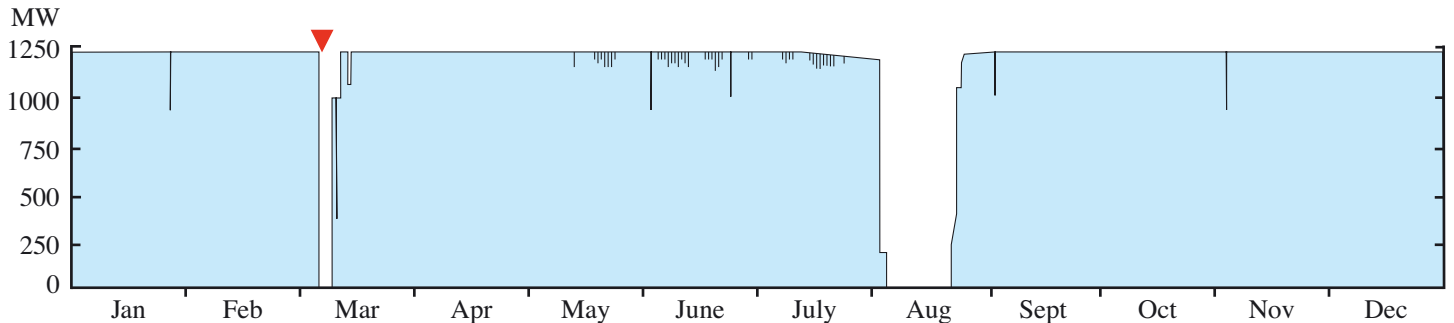
History

Characteristics



Leibstadt

Operating Experience 2007



Important to Safety

Scrams:

There was one automatic scram during power operation.

March 6: Inadvertent initiation of the Automatic Depressurization System (ADS) during planned maintenance on the Special Emergency Heat Removal (SEHR) system Division 51 resulted in a reactor scram in accordance with plant design.

Important to Availability

January 27: MSIV monitoring and Control Rod pattern adjustment.

March 9 to 10: Oscillations in the Main Turbine control system.

March 13: Control Rod pattern adjustment.

June 2: MSIV monitoring and Control Rod pattern adjustment.

June 23: Control Rod pattern adjustment.

July 12: Begin End-Of-Cycle Coastdown.

August 4 to 22: 23rd Refueling Outage
– Duration was 17.4 days (scheduled 17.6).
– Loaded 128 new and reinserted 9 fuel bundles (out of 648).

September 1: Control Rod pattern adjustment.

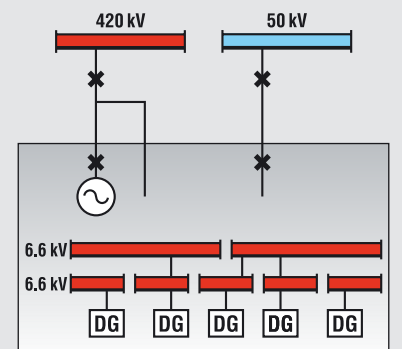
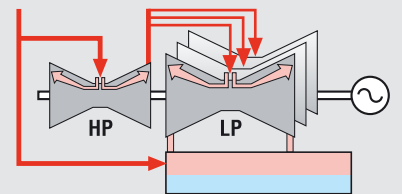
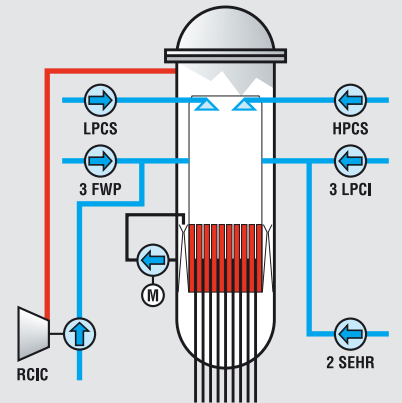
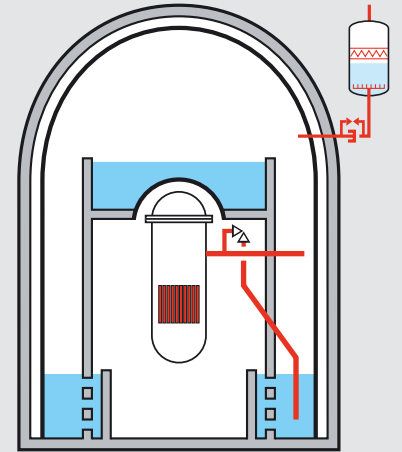
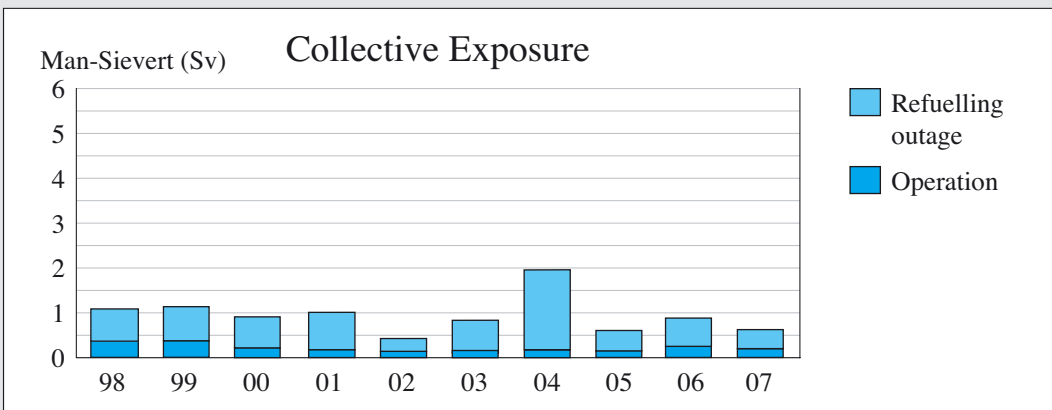
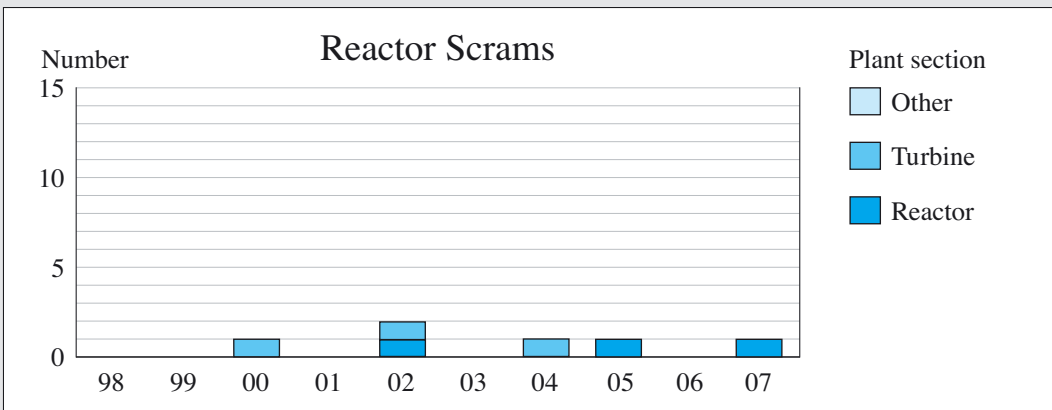
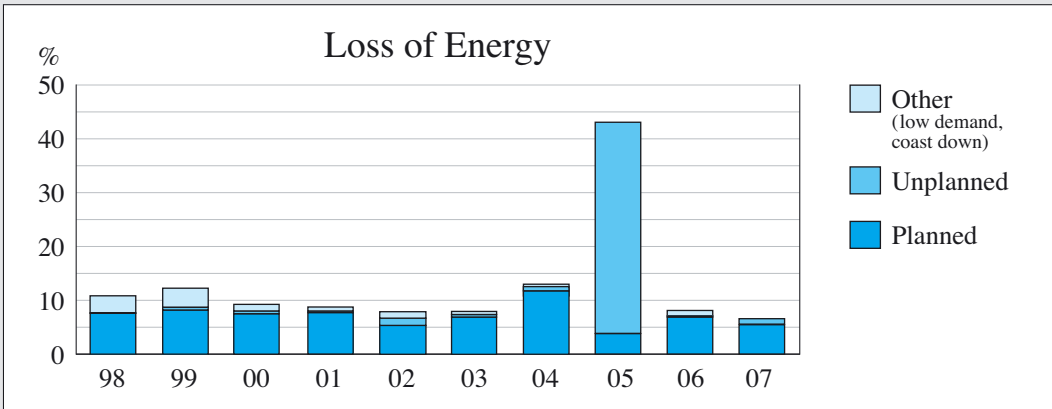
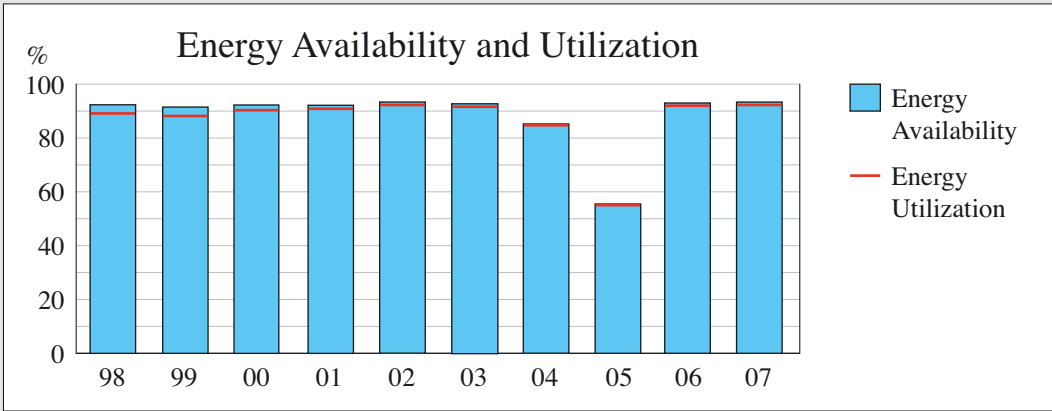
November 3: MSIV monitoring.

May/June/July: Small load reductions due to higher condenser pressure caused by high ambient temperature conditions.

Net Production	9436801 MWh
Energy Availability	93,4%
Energy Utilization	92,8%

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 AG.

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, 40.0%, managing partner)
- Nordostschweizerische Kraftwerke AG (NOK, 25.0%)
- the City of Zurich (15.0%)
- Centralschweizerische Kraftwerke AG (CKW, 12.5%)
- Energie Wasser Bern (EWB, 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, 27.4%)
- Elektrizitäts-Gesellschaft Laufenburg AG (EGL, 16.3%)
- Centralschweizerische Kraftwerke AG (CKW, 13.6%)
- BKW FMB Energie AG (9.5%)
- AEW Energie AG (5.4%)
- Energie Ouest Suisse, Lausanne (EOS, 5.0%)

The report is available on the web site:

<http://www.nuklearforum.ch> → Fakten → Summary of Operating Experience

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