WIKIPEDIA

Lucen's reactor

The **Lucens experimental** *nuclear power* **plant** (*VAKL for short*), also known as the **Lucens reactor** , is an underground experimental power **reactor** that was built in the Swiss town of Lucens in the canton of Vaud in the 1960s . The heavy water reactor built is a Swiss in-house development and was based on research work at Reaktor AG (today's Paul Scherrer Institute) in Würenlingen . Construction began in 1961. After long delays, the reactor was handed over to Energie Ouest Suisse (EOS) for operation on May 10, 1968 . After an interim revision, when operations were resumed on January 21, 1969, a fuel element partially melted, which resulted in the pressure tube bursting and serious damage to the reactor core, making it impossible to continue operating the reactor.

contents

[Lucen's reactor. (Accessed Mar. 21, 2021). Overview, Sulzer, Escher Wyss, Boverie, ETH Zurich, Reacktor, 1945. Swiss Military Study Commission for Atomic Energy. de.zxc.wiki. Source: https://de.zxc.wiki/wiki/Reaktor_Lucens]

History of the Swiss reactor line

In 1945, on the initiative of the Swiss Military Department (EMD), the so-called «Study Commission for Atomic Energy» (SKA) was founded. Subsequently, all well-known Swiss research institutes dealing with nuclear energy were represented in the SKA. In 1952, the SKA commissioned a consortium in which companies such as Brown, Boveri & Cie. , Sulzer and Escher Wyss were represented, planning a test reactor. This reactor was to be built by industry, but with financial support from the SKA. In 1953 the finished plans for the experimental reactor were presented. However, they have not yet been implemented.

Research work at Reaktor AG in Würenlingen

In 1955, Walter Boveri Jr., President of Brown, founded Boveri & Cie. , in cooperation with business and the ETH Zurich in Würenlingen the Reaktor AG. In the same year, the first Geneva nuclear conference took place in Geneva . At the conference, the American Atomic Energy Agency (AEC) presented the possibilities of nuclear energy on a specially built light water reactor . Since the return transport of the test reactor would have involved considerable effort for the Americans, the Swiss Confederation was able to acquire the reactor very cheaply and then sell it on to Reaktor AG. While this reactor, named "Saphir" because of its blue glow, was being set up at its new location in Würenlingen, work on another research reactor called Diorit began at the same time . The diorite was a heavy water reactor based on the plans for the SKA test reactor. Although it had already been established at the Geneva nuclear conference that the Swiss reactor concept was long out of date, construction work began and in 1960 the diorite became critical for the first time .

Applications for subsidies for experimental power reactors

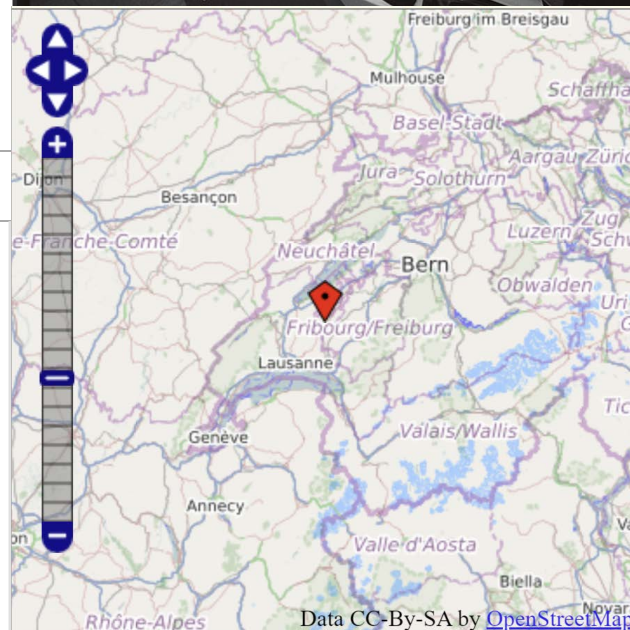
Parallel to the research work of Reaktor AG, three industrial groups worked on projects for experimental power reactors between 1956 and 1959. The experimental power reactors were intended to be the next step on the road to commercial reactors. By 1959, the three groups submitted their projects to the federal government for subsidies.

The three projects were:

1. Consortium: The consortium was an amalgamation of German-Swiss industrial companies (including Sulzer, Escher Wyss and Brown, Boveri & Cie.), Who had set themselves the goal of building a nuclear heating power station underground in the city of Zurich (under the buildings of the ETH) to build. The reactor type should correspond to that of the diorite.
2. Enusa: Numerous western Swiss industrial companies, planning offices and the electricity company EOS came together in Enusa. The plan was to (re) build an American, light water moderated reactor in Lucens in the canton of Vaud.
3. Suisatom was founded by the four largest Swiss electricity companies (NOK , Atel , BKW and

Lucen's reactor

Control room of the Lucens experimental nuclear power plant (1968)



object			
Type	Landmark	Scale	± 1: 10000

Coordinates	553207 / 171473
country	Switzerland
Data	
owner	National Society for the Promotion of Industrial Nuclear Technology
operator	Energie Ouest Suisse
start of building	April 1, 1962
Installation	May 10, 1968
Shutdown	January 21, 1969
Shutdown	March 3, 1969
Reactor	Heavy water reactor

EOS). The project included the purchase of an American light water reactor. Construction management and the delivery of the secondary parts should be at Brown, Boveri & Cie. lie.

type	
Thermal performance	30 MW
Website	https://www.ensi.ch/fr/themes/centrale-nucleaire-lucens

The Federal Council had all three applications examined by an external group of experts and finally recommended that the Federal Assembly support the construction of a test power reactor with up to 50 million francs. He made it clear that he would be willing to co-finance both the consortium and Enusa projects, but not the Suisatom reactor. However, the Federal Council wanted to leave the decision as to which reactor should ultimately be built to the private sector.

In March 1960, both the Council of States and the National Council followed the proposal of the Federal Council and approved the funds amounting to 50 million francs. The condition was that the federal contributions should not exceed 50 percent of the total expenditure. Likewise, the three applicants for the construction should join together in a single umbrella company.

The construction of the reactor in Lucens

Just two weeks after the federal parliaments accepted the proposal, Enusa and Thermatom, the successor organization to the consortium, agreed to build a joint test power plant. It was a compromise: At the location of the Enusa project, Lucens, the reactor plans of the consortium or Therm-Atom, the successor organization of the consortium consisting of 22 industrial companies from all over Switzerland, were to be implemented. In the summer of 1961 the umbrella company called for by the federal government was founded: Thermatom, Enusa and Suisatom jointly founded the “National Society for the Promotion of Industrial Nuclear Technology” (NGA). Former Federal Councilor Hans Streuli took over the management of the NGA, who subsequently became the main driving force behind the construction of Lucens.

One year after the founding of the NGA, the groundbreaking for the construction of the reactor took place on July 1, 1962.

Construction and reactor design

The Lucens plant was built two kilometers southwest of the village of Lucens on the banks of the Broye , which was initially also intended for the cooling water. With the exception of a few operating and storage buildings, the entire system was laid underground in three rock caverns.

The plant concept of the experimental nuclear power plant was based on the following specifications:

- Natural uranium as a fissile material: Uranium deposits are found in many places. Natural uranium can be freely traded and easily stored. Refraining from enriching uranium avoids the associated high costs and bypasses the monopoly of the few producers and the political barriers against this process. Due to the small size of the reactor core, slightly enriched uranium was used in the Lucens test facility.
- Heavy water as moderator: The use of natural uranium as a fissile material was practically only possible together with graphite or heavy water as moderator. The advantages of heavy water over graphite are better neutron economy with better utilization of uranium, the possibility of a more compact design of the reactor and easier manufacture in Switzerland. The goal of developing a heavy water moderated reactor with natural uranium as a fissile material in Switzerland was formulated in 1952 by the Study Commission for Atomic Energy SKA and in the following years served as the basis for decisions by industry and applications to the Federal Council. There were similar developments with the realization of prototypes in Sweden, Canada, France, Germany and Great Britain.
- Carbon dioxide gas as coolant: Heavy water, light water, light water vapor, diphenyl and carbon dioxide were considered as coolants for the removal of thermal energy from the reactor core. When deciding in favor of gas in the case of the Lucens prototype, experience with the British and French gas-cooled and graphite-moderated reactors, the higher temperatures that can be achieved and experience with gas-heated steam generators played a role; the

initially favored heavy water was ruled out because of the higher costs and the expected tritium radiation. In the later studies for larger systems, variants with light water were also examined.

- Bundles of uranium metal rods with a magnesium shell as fuel element: Uranium metal results in better neutron economy when using natural uranium compared to the less corrosive uranium oxide that will later be used for larger plants. In the chosen solution, it was also possible to build on the experience from the British and French reactors.
- Pressure pipes as a pressure-maintaining component in the reactor core: because only the coolant - but not the moderator - was dependent on high pressure, a pressure pipe construction could be used. It was hoped that this would result in almost any scalability to larger systems and the development steps for large pressure vessels, which were more difficult at the time, and proof of their safety could be dispensed with.
- Rock cavern as containment: The subterranean arrangement of power plant control centers had proven itself in the hydropower plants and so it made sense to also accommodate the most important parts of the nuclear power plant in rock caverns. This construction method was also practiced in Norway and Sweden at the time. In addition to protection against external influences, the porous sandstone in Lucens also offered a special option for retaining radioactive substances. Active substances that get there through leakage or controlled pressure relief would be stored in the pores for a long time and disintegrate in the course of their diffusion towards the environment. In this specific case, this concept had to be supplemented by a ventilation hood equipped with filters due to problems with the sealing against the access tunnel.

Delays, Obstacles, and Operation

The construction of the reactor in Lucens was marked by several breakdowns and financial problems. The first big damper for Swiss in-house development occurred on February 7, 1963, when it became known that the NOK was planning to build a turnkey American light water reactor in Beznau . A little later, other electricity companies followed with their own purchase intentions. The actual target group of Swiss reactor technology had thus stocked up on the foreign competition even before the plant in Lucens was even completed. Meanwhile, costs in Lucens got out of hand and the schedule had to be revised. At the end of 1963, cracks formed in the rock after blasting, after which the construction work had to be stopped for several weeks. Again and again one had to struggle with water ingress during construction. The cavern leaked in 1965 and the drainage system had to be revised. So the cavern, which was originally supposed to provide security, became more and more a security problem. It was seething inside the NGA as well: Brown, Boveri & Cie. and Sulzer from open conflicts. The initially planned costs of 64.5 million Swiss francs rose to 112.3 million Swiss francs by the time the final settlement was made. The federal government repeatedly approved additional loans worth millions of euros without discussion. Problems with the fuel elements were far more serious than the rising costs: In May 1966, the planned fuel elements were to be tested in the diorite in Würenlingen. However, one fuel element partially melted and the affected test circuit in the research reactor had to be completely dismantled and decontaminated. Because a similar process in the Lucens reactor could be ruled out, the existing design was retained in agreement with the safety authorities. On May 8, 1967, Sulzer announced its withdrawal from Swiss nuclear technology development. The reactor development will only be continued within the framework of the contract with the CEA and Siemens. With the withdrawal of the most important company, Lucens was about to end, but former Federal Councilor Hans Streuli still did not want to give up. The electricity company EOS was supposed to operate the plant for two years after completion. On December 29, 1966, the reactor became critical for the first time, which means that a self-sustaining chain reaction of uranium fission could be maintained. After the first attempts at zero output, completion of the assembly work and acceptance tests for the plant components that are important for power operation, the plant generated the first nuclear power in Switzerland on January 29, 1968. The plant was handed over to the electricity company EOS, which is responsible for its operation, on May 10, 1968 after a ten-day acceptance test with at least 21 MW output. The plant was then operated with outputs of up to a nominal value of 30 MW. In a shutdown phase from November 1968 to mid-January 1969, a series of overhaul work was carried out, including examination of a dismantled fuel assembly and renovation of the shaft seals of the circulating fan. It was planned to operate until the end of 1969 in order to gain experience with the plant, its z. Partly newly developed components and their operation. Because self-supporting operation was not possible, the plant was then to be shut down. The final abandonment of the development of heavy water reactors in Switzerland - and also in other European countries -

was due to the major changes in the political, economic and technical conditions that occurred in the course of the 1960s. These were in particular the easy availability of enriched uranium, the rapid trend towards very large unit outputs, the dominant position of the American light water reactors and the lack of interest from local electricity companies.

The accident of January 21, 1969

Aerial shot July 4th 1969

On January 21, 1969, operations were resumed after an overhaul. Several fuel elements overheated during the increase in reactor output. Fuel element no. 59 heated up so much that it melted and eventually burst the pressure tube. 1100 kg heavy water, molten radioactive material and radioactive gases were thrown into the reactor cavern. The active substances released from the molten uranium triggered a rapid shutdown of the reactor a few seconds before the pressure pipe burst. The operating personnel present were able to determine from the information available in the control room within the first few minutes that the primary circuit had broken, but the reactor was safely shut down and the cooling of the reactor core ensured. They initiated the necessary measures according to the corresponding emergency plan and were able to determine a provisionally safe condition of the plant and its surroundings. After an hour, increased radioactivity was also found in the other cavern facilities, which meant that the reactor cavern was not sealed. Measurements in the surrounding villages revealed an increase in radioactivity. There were no inadmissible doses of radiation from the accident, either inside or outside the facility.

The accident caused an estimated $ 26 million in damage.

Investigation of the accident and decontamination of the reactor

In the aftermath of the accident, a commission of inquiry was set up to determine the cause of the accident. Only after ten years did it publish a final report in 1979. It was concluded that during the revision work from autumn 1968 to January 1969, water must have accumulated in some fuel elements, which caused the elements to corrode partially from the inside. The space for the cooling gas had narrowed considerably in some places due to corrosion deposits. The reduced cooling capacity resulted in several elements overheating, which ultimately led to a partial core meltdown. The ingress of water into the reactor cooling circuit and the reactor core was a consequence of problems with the sealing water seal of the cooling gas circulation fans. The testing of new sealing rings took place in the Lucens plant after the test stand was no longer available at the blower manufacturer; an unexpectedly large amount of water entered the circuit unnoticed. The possibility of an accident of the type that had occurred was described in the safety documents and was known to both the project engineers and the safety authorities. Measures to limit the extent of the accident - in particular reinforced calender tubes and rupture discs in the calender tank - have been implemented and have proven themselves in the event that occurred.

The decontamination and dismantling of the reactor dragged on until the end of 1971. A total of 250 barrels of radioactive waste was produced. In 2003 these barrels were transported from Lucens to Zwilag in Würenlingen in the canton of Aargau. As already mentioned, it was decided in 1967 to stop the development of a Swiss heavy water reactor. Contrary to popular opinions, the accident in January 1969 was not the cause of this termination.

Possible military use of the reactor

In the specialist literature it is controversial to what extent military intentions were pursued with the construction of the reactor in Lucens. In his licentiate thesis in 1987, Peter Hug clearly advocated a military orientation . In 1994 Roland Kollert saw the Lucens reactor as a dual-use reactor that was to be used both for power generation and for the production of weapons plutonium. The military thesis was contradicted first in 1995 by Dominik Metzler and then later in 2003 by Tobias Wildi . Both drew attention to the fact that, unlike Hug, new sources were available to them. However, in a review Jan Hodel criticized the lack of a clear comparison of these new findings with Hug's arguments in Wildi's work.

On behalf of the project planners and designers involved in the development of the Lucens reactor, the possibility of military use was never requested and never mentioned. If such an objective had existed, the system would have had to be provided with a device for changing fuel assemblies while the reactor was running, for example in connection with the low burn-up of fissile material that would then be necessary. In fact, the highest possible burn-up was aimed for.

According to Urs Hochstrasser , then the Federal Council's delegate for nuclear energy issues, the enriched uranium and heavy water for Lucens were supplied by the USA with the condition that these materials were used exclusively for peaceful purposes. To ensure compliance with this obligation, the Federal Council has initially accepted a control by the supplier state and later by the UN International Atomic Energy Agency. It was actually checked by appropriate inspections.

See also : Swiss nuclear weapons program

Current situation

In accordance with its mandate, the Federal Office of Public Health has been carrying out regular measurements in the drainage systems of the former Lucens experimental reactor since 1995 and informing the cantonal and local authorities. Cesium -137 and cesium-134 as well as cobalt -60, tritium and strontium -90 are measured . Between 2001 and 2010, an average tritium activity of 15 Bq / L was measured in the water samples . Since 2010 there have been isolated slightly increased values. However, the values have only increased significantly since the end of 2011 (up to 230 Bq / L).

See also

- List of nuclear accidents
- List of nuclear reactors in Switzerland

literature

- C. Perotto: Problems of radiation protection during the incident in the Lucens experimental reactor on January 21, 1969. (http://bibliothek.fzk.de/zb/kfk-berichte/KFK1638.pdf) (PDF; 15 MB) Nuclear Research Center Karlsruhe KFK 1638 Conference from 17. – 19. May 1972 in Karlsruhe: Radiation protection at work pp. 51–56.
- Susan Boos: *Radiant Switzerland: Handbook on the nuclear industry* . Rotpunktverlag, Zurich 1999, ISBN 978-3-85869-167-5 .
- Peter Hug: *History of the development of atomic technology* . Licentiate thesis, Bern 1987.
- Peter Hug: *Electricity Industry and Nuclear Power. The unsuccessful wooing of the Swiss reactor builders for the electricity industry 1945–1964* . In: David Gugerli (ed.): *Almighty sorceress of our time. On the history of electrical energy in Switzerland* . Chronos, Zurich 1994, ISBN 978-3-905311-58-7 , pp. 167-183.
- Peter Hug: *Nuclear technology development in Switzerland between military interests and private sector skepticism* . In: Bettina Heintz, Bernhard Nievergelt: *Science and technology research in Switzerland* . Seismo Verlag, Zurich 1998, ISBN 978-3-908239-61-1 , pp. 225–242.
- Roland Kollert: *The politics of latent proliferation. Military use of "peaceful" nuclear technology in Western Europe* . Deutscher Universitäts-Verlag, Wiesbaden 1994, ISBN 978-3-8244-4156-3 .
- Patrick Kupper: *Atomic energy and a divided society. The story of the failed Kaiseraugst nuclear power plant project* . Chronos, Zurich 2003, ISBN 978-3-0340-0595-1 .

- Dominik Metzler: *The option of nuclear armament for the Swiss army (1945–1969)* . Licentiate thesis, Basel 1995.
- Tobias Wildi: *The ruins of Lucens. A failed innovation in a national context (https://web.archive.org/web/20110409114928/http://wildi.hist.ch/publikationen/2001_Wildi_Truemmer.pdf) (memento of April 9, 2011 in the* Internet Archive *).* In: Hans-Jörg Gilomen et al. (Ed.): *Innovations. Requirements and consequences - driving forces and resistance* . Chronos, Zurich 2001, ISBN 978-3-0340-0518-0 , pp. 421-436.
- Tobias Wildi: *The dream of your own reactor. Swiss nuclear technology development 1945–1969* . Chronos, Zurich 2003, ISBN 978-3-0340-0594-4 .
- Tobias Wildi: *The Reaktor AG: nuclear technology between industry, university and state* . In: *Swiss History Journal* . Volume 55, 1/2005, pp. 70-83 (doi : 10.5169 / seals-81386 (https://doi.org/10.5169/seals-81386)).

swell

- Working group Lucens: *Lucens experimental nuclear power plant. Final report* . 1969.
- *Message from the Federal Council to the Federal Assembly on the promotion of the construction and experimental operation of experimental power reactors* . January 26, 1960. In: *Bundesblatt.* dated February 11, 1960. Issue 6, Volume 1, pp. 473-495.
- *Federal decree on the promotion of the construction and experimental operation of experimental power reactors* . March 15, 1960, In: *Bundesblatt.* of March 31, 1960. Issue 13, Volume 1, pp. 1222-1223.
- Paul Ribaux: *The Lucens experimental nuclear power plant* . In: Swiss Society *of Nuclear* Specialists (Ed.): *History of nuclear technology in Switzerland. The first 30 years 1939–1969* . Oberbözberg 1992, pp. 133-149.
- *Final report on the incident in the Lucens experimental nuclear power plant* . 1979.
- Bruno Pellaud: *The beginnings in Switzerland.* In: Swiss Society of Core Experts (ed.): *History of nuclear technology in Switzerland, The first 30 years 1939–1969.* Oberbözberg 1992, pp. 29-45.
- Otto Lüscher: *The Swiss reactor line.* In: Swiss Society of Core Experts (ed.): *History of nuclear technology in Switzerland, The first 30 years 1939–1969.* Oberbözberg 1992, pp. 115-131.
- Roland Naegelin: *History of the safety* supervision of *the Swiss nuclear facilities 1960–2003.* Villigen 2007, ISBN 3-907-97456-0
- David Mosey: *Reactor Accidents, Nuclear Safety and the Role of Institutional Failure.* 1990, ISBN 0-408-06198-7 . British Library.

Documentation

- Traces of Time: The Atomic Dream (https://www.srf.ch/play/suche?query=Eine%20Schweizer%20Atombombe%20f%C3%BCr%20den%20Frieden) : SF documentary about the Lucens reactor. (Online video, 45 min) (http://www.srf.ch/player/tv/srf-wissen/video/eine-schweizer-atombombe-fuer-den-frieden?id=28316e37-f937-4652-81de-e47d26d96ccd)

Web links

Commons : Reaktor Lucens (https://commons.wikimedia.org/wiki/Category:Lucens_nuclear_reactor?uselang=de) - collection of images, videos and audio files

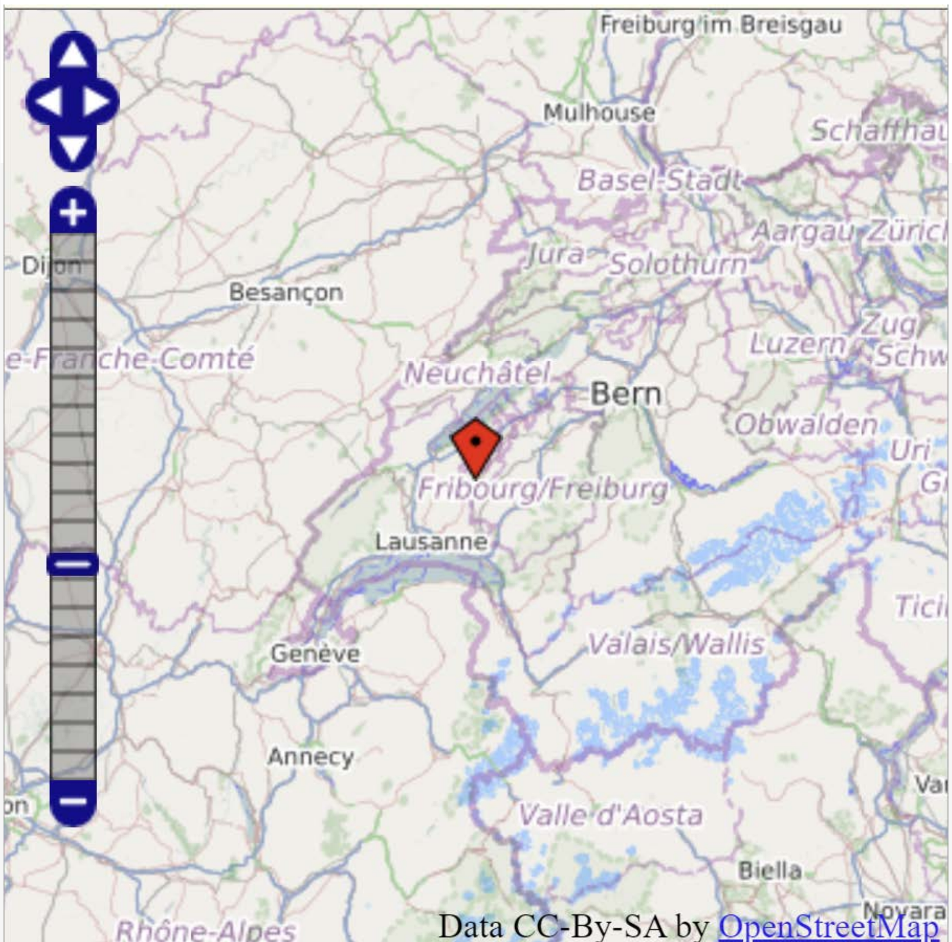
- The dream of the Swiss reactor (http://www.library.ethz.ch/exhibit/Traum_Reaktor/inhalt.html) : Image documentation from ETH in connection with an exhibition
- Was the construction of the Swiss experimental power reactor militarily oriented? (http://www.zeme.ch/userfiles/pdfs/War_der_Bau_von_Lucens_militaerisch_orientiert.pdf): Seminar paper on this question
- Peter Hug: *Atomic Energy.* (https://hls-dhs-dss.ch/de/articles/017356)In: *Historical Lexicon of Switzerland* .
- When Switzerland escaped a nuclear disaster (http://bazonline.ch/wissen/technik/Vor-40-Jahren-Aus-der-Traum-von-schweizerischem-Atomreaktor/story/30369828) : Article in the Basler Zeitung
- … 41 years: meltdown in a Swiss reactor (http://bazonline.ch/wissen/geschichte/-41-Jahren-Kernschmelze-in-Schweizer-Reaktor/story/10879035) : Another article in the Basler Zeitung
- The forgotten Swiss nuclear disaster (http://www.20min.ch/news/dossier/atomenergie/story/24705594) : Article in the commuter newspaper 20 Minuten
- The nuclear test reactor in Lucens (http://www.ideesuisse.ch/212.0.html) : Short film about the construction site in Lucens from 1965 (French)

- Transport of waste from Lucens to the ZWILAG (http://www.bfe.admin.ch/energie/00588/00589/00644/index.html?lang=de&msg-id=1412) : press release by the Swiss Federal Office of Energy
- Lucens experimental (https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-1031.html) nuclear power plant (https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-1031.html) : Further press release by the SFOE
- Finding aids for the “Archive on the History of Nuclear Energy in Switzerland” in the ETH Zurich University Archives doi : 10.3929 / ethz-a-005148646 (https://doi.org/10.3929/ethz-a-005148646)
- Series of articles by the Swiss Federal Nuclear Safety Inspectorate ENSI on the Lucens experimental nuclear power plant (https://www.ensi.ch/de/themen/versuchsatomkraftwerk-lucens/) : ENSI website

Individual evidence

1. Wildi 2003, pp. 27-28.
2. Wildi 2003, pp. 46-47
3. Wildi 2005.
4. Wildi 2003, p. 81.
5. Was the construction of the Swiss experimental power reactor militarily oriented? (http://www.zeme.ch/userfiles/pdfs/War_der_Bau_von_Lucens_militaerisch_orientiert.pdf), P. 7.
6. Message from the Federal Council to the Federal Assembly on the promotion of the construction and experimental operation of experimental power reactors 1960, p. 485.
7. Federal decree on the promotion of the construction and experimental operation of experimental power reactors 1960.
8. Lüscher 1992, p. 126.
9. Wildi 2003, pp. 140-142
10. Wildi 2003, p. 171
11. Ribaux 1992, pp. 140-141.
12. Wildi 2003, pp. 194-195.
13. Wildi 2003, pp. 210-211.
14. Wildi 2003, p. 215.
15. Wildi 2003, p. 222.
16. Wildi 2003, p. 224.
17. Wildi 2003, p. 238.
18. *Lucens series: Detailed analysis of the accident.* (https://www.ensi.ch/de/2012/05/31/serie-lucens-ausfuehrliche-analyse-des-unfalls/)In: *ensi.ch.* Federal Nuclear Safety Inspectorate ENSI, May 31, 2012, accessed on January 5, 2019 .
19. http://www.tagesschau.de/wirtschaft/atomunfaelle-schadenskosten102.html
20. Final report on the incident in the Lucens experimental nuclear power plant. 1979.
21. G. Bart: *Anniversary Annual Report Hotlabor - Clarifications on the incident in the Lucens nuclear power plant from January 21, 1969.* (http://inis.iaea.org/search/search.aspx?orig_q=RN:21014586) Paul Scherrer Institute , July 1989, pp. 37-39 , accessed March 14, 2011 .
22. Wildi 2001, p. 421.
23. Federal Office of Energy: Lucens experimental nuclear power plant (https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-1031.html)
24. Hug 1987, p. 122.
25. Kollert 1994.
26. Roman Schürmann: *Helvetische Jäger. Dramas and scandals in the military sky.* Rotpunktverlag, Zurich 2009, ISBN 978-3-85869-406-5 , p. 135 ff.
27. "If necessary, also against the own population" (http://www.tagesanzeiger.ch/schweiz/standard/Notfalls-auch-gegen-die-eigene-Bevoelkerung/story/12637325) in: Tages-Anzeiger of January 28, 2011

28. Metzler 1995; Wildi 2003.
29. T. Wildi and P. Kupper: Atomic energy in Switzerland (http://hsozkult.geschichte.hu-berlin.de/rezensionen/2004-4-186)
30. Federal Office of Public Health: Press release (https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-44057.html) , April 4, 2012



object			
Type	Landmark	**Scale**	± 1: 10000