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# The West German educational reactor SUR-100 and its diplomatically intended export to Latin America

**Résumé**
Développé en Allemagne de l’Ouest dans les années 1960, le réacteur de puissance nulle SIEMENS type SUR-100 fut conçu à la fois à des fins pédagogiques et comme objet de démonstration pour une discipline de l’ingénierie encore en émergence. Par la suite, il acquit aussi une signification diplomatique : en plus d’être installé dans plusieurs universités allemandes à partir de 1963, deux exemplaires furent également envoyés en Amérique latine en guise de cadeau du gouvernement allemand. Ces exemplaires étaient destinés à la fois à promouvoir la technologie allemande des réacteurs en Amérique latine et à lier les physiciens des réacteurs argentins et mexicains à la technologie nucléaire allemande en rendant les cours en République fédérale contractuellement obligatoires.

**Plan de l’article**

→ Preconditions and development of the SUR-100
→ Key technical data of the SUR-100
→ The SUR-100 as a form of “development aid”
→ Mexico
→ Rosario, Argentina
→ Dismantling
→ Discussion

> *"Advantage is to be seen in the fact that the student can immediately overlook the basic structure of the reactor and thus understand the physically important relationships."*[1]

1 This article will discuss a rather atypical kind of a nuclear export, which, however, became effective in a very pragmatic way: through the development and dissemination of the SIEMENS type SUR-100 teaching reactor. The SUR-100 was intended to give engineering students in Germany, Argentina and Mexico "as broad a spectrum of experience as possible for later use".[2]

2 This topic is interesting for the consideration of energy history because it represents an important chapter in the development of "stirrup holders". Exporting states of technical solutions for the civil use of nuclear energy used the gift of research and training reactors to emerging and developing countries because they hoped scientific personnel at the training facilities could practice on special technical designs of the research reactors and the 'generous' gesture would lead to governments opting for the purchase of reactors of the exporting country for the construction of nuclear power plants (especially the USA chose this way of 'mild gift' to emerging countries, an example is Morocco).[3]

3 The topic of the German export of teaching reactors to developing and newly industrializing countries has not yet been investigated, nor has the history and use of the Siemens SUR-100 teaching reactor in general. This article aims to clarify both open points. Not only have archival records in the Federal Archives in Koblenz not been used to date, but inquiries have been made to all university archives as well as chairs that formerly operated the SUR-100 in Germany, Mexico, and Argentina, and materials have been evaluated. There has been no secondary literature on the subject, and many archives have yet to receive requests to inspect records. At a few institutions, the SUR-100 is still in operation, so the writing of history has not yet begun.

The article first presents the development and design of the SUR-100 and then details the political intentions that led to the West German government's gift to developing and emerging countries. 4

## PRECONDITIONS AND DEVELOPMENT OF THE SUR-100

In the late 1950s, the need for training opportunities in the field of reactor technology increased in universities within the Federal Republic of Germany.[4] Due to international embargoes after World War II, German universities were not allowed to engage in the research and development of nuclear technology on a larger scale until 1955. As a result, there was an enormous need to catch up with other industrialized nations. The first German nuclear research reactors still had to be imported from the USA.[5] 5

Although the first faculty chairs for reactor technology were approved in 1955, they remained unfilled for a long time, e.g., at RWTH Aachen University of Technology, because there were no suitable candidates with German language skills due to a lack of previous training in the field. It was possible to study reactor technology as early as 1955, however this was carried out primarily by lecturers within the industry, not from academic institutions.[6] There was an additional lack of qualified engineers for several years and no facilities in which to train future engineers in isotope technology and reactor construction. However, engineering students increasingly needed to be 6

1 Gerd Grenz, *Systematische Untersuchung zur Frage der optimalen Nutzung eines Unterrichtsreaktors für Ausbildungszwecke unter Berücksichtigung der fachlichen Anforderungen der Industrie an die Absolventen. Forschungsberichte des Landes Nordrhein-Westfalen Nr. 1954* (Opladen: Westdeutscher Verlag, 1968), 14.

2 Ibidem., 8.

3 Matthew Adamson, "Orphaned atoms: The first Moroccan reactor and the frameworks of nuclear diplomacy," *Centaurus*, vol. 63, n°2, 2020.

4 Ibidem., 3.

5 Michael Eckart, "Die Anfänge der Atompolitik in der Bundesrepublik Deutschland", *Vierteljahreshefte für Zeitgeschichte*, vol. 37, n° 1, 1989, 43.

6 Minutes of the Senate Meeting of RWTH Aachen University, February 21, 1963, RWTH Aachen, University Archives Sig. N0106-B., p. 7f.

familiar with the fundamentals of nuclear technology, and especially reactor safety.[7]

7 The job profile of the engineer was also changing at that time. Classical mechanical engineering students or budding designers increasingly became development and research engineers working in laboratories. Above all, the development of reactor physics and thermodynamic calculations for reactor designs were among the new central tasks for future engineers in nuclear technology.[8]

8 In the 1960s, reactor physics and reactor technology were introduced into the curricula of various German universities and technical colleges: "In a subject which, in some respects, is based on very complex phenomena that have hardly entered into everyday experience, it is necessary that, in addition to the transmission of knowledge in lectures and exercises, the most important findings should also be deepened by means of well-prepared and properly equipped practical courses," writes Grenz (1968). A nuclear reactor that could be operated only for teaching purposes and as a demonstration piece presented itself as an "ideal opportunity" for universities. The SUR-100, whose first prototype was commissioned in 1961 at the SIEMENS-Schuckertwerke reactor station in Garching, remained the only demonstration reactor of this type and size offered in Europe until the late 1960s. It was set up in the reactor station next to the SIEMENS Argonaut Research Reactor (SAR), which had been in operation since June 1959.[9] Comparable teaching reactors of this type were available only in the USA at that time.[10]

In October 1961, a first, positive expert opinion was issued on the safety of the SUR-100 in Garching. As a result, the TU Berlin and the Technische Hochschule Darmstadt were the first universities to order a SUR-100 from SIEMENS. In January 1961, the RWTH Aachen University of Technology also submitted an application to the Federal Ministry for Scientific Research for the provision of funds to procure a teaching reactor. At that time, acquisition costs for such reactors could reach up to DM 800,000, and financing for the reactor was insufficient. An acquisition was therefore uncertain, since a sum of only 400,000 DM was made available by the Ministry.[11] Since the SUR-100 was launched in the same year, and only cost 400,000 DM, the Senate of RWTH Aachen approved the purchase of the SUR-100 as a "teaching aid", since it did not represent a research facility in the classical sense.[12] 9

On July 17, 1963, at 17:19, the SUR-100 at the University of Technology Berlin became the first regular German training reactor to go critical.[13] The SUR-100 was also the first reactor ever to be built by a German company without foreign assistance. The possible applications of this new zero-power reactor were exclusively in the fields of teaching and training. It was to be used at the TU Berlin mainly for reactor physics experiments and as a neutron source. For the first time, it also offered the opportunity for one to become familiar with the basics of radiation protection measurement as part of one's studies: "Specialized training at the large reactor centers will therefore be all the more fruitful the more one can already build on basic knowledge."[14] With regards to the 10

**7** Grenz, *Systematische Untersuchung* (cf note 2), 7.
**8** Ibidem., 9.
**9** Günter Hildenbrand, "Der SIEMENS-Unterrichts-Reaktor SUR-100", *Sonderdruck aus der SIEMENS-ZEITSCHRIFT*, vol. 35, n°4, 1961, 224-227.
**10** Letter from SIEMENS-Schuckertwerke to the Managing Director of the German Reactor Safety Commission at the Federal Ministry for Nuclear Energy and Water Management, April 7, 1961. Bundesarchiv Koblenz; B 138/3369, Bd. 51961, Bandnummer 5: "Vorschläge für die Durchführung kerntechnischer Praktika unter Verwendung des SIEMENS-Unterrichtsreaktors SUR 100", Aktenzeichen 1901-431, Organisationseinheit II D, Bezugsjahr 1961, p. 160.
**11** Minutes of the Senate Meeting of RWTH Aachen University, February 21, 1963. RWTH Aachen, University Archives Sig. N0106-B, p. 7f.
**12** Minutes of the Senate Meeting of RWTH Aachen University, May 16, 1963. RWTH Aachen, University Archives Sig. N0106-B., p. 6f.
**13** Telegram from the TU Berlin to the German Atomic Commission vom 17. Juli 1963. Bundesarchiv Koblenz; B 138/3369, Bd. 51961, Bandnummer 5: "Vorschläge für die Durchführung kerntechnischer Praktika unter Verwendung des SIEMENS-Unterrichtsreaktors SUR 100", Aktenzeichen 1901-431, Organisationseinheit II D, Bezugsjahr 1961, p. 5.
**14** Press release of SIEMENS AG: "Auftrag für den 10. SIEMENS-Unterrichts-Reaktor", AR 74 80-6603 HRO

nuclear industry, the demand for qualified engineers in this field had steadily increased. In a field which, in some respects, is based on very complex phenomena that have hardly entered into everyday experience, it is necessary that, in addition to the transmission of knowledge in lectures and exercises, the most important findings are also deepened with the aid of well-prepared and properly equipped practical courses. The development of a nuclear reactor, which has been specially designed for teaching purposes, offers the ideal opportunity to make such a practical course versatile and practical. [15]

11 Teaching will always remain one-sided and theoretical without the inclusion of experimental demonstrations. The ever-closer relationship between science and technology, as well as the increasingly necessary cooperation of different working groups (teamwork), require a language that is as common as possible to all participants (...). Specialized training at large reactor centers will be all the more fruitful the more the trainees become familiar with the basic facts.“[16] Set-up and instrumentation were explained directly at the reactor.[17]

## KEY TECHNICAL DATA OF THE SUR-100

12 The SUR-100 was a so-called “homogeneous thermal reactor” with a standard power of 100mW (cf. fig.1). It differed from other research reactors of the period by its much lower power. One advantage was the low purchase and operating costs, as well as the possibility to choose a normal room within the university as the location for the reactor, even in a densely populated urban environment (at the University of Technology Berlin/ TU, for example, the SUR-100 was located only a few hundred meters away from the Zoologischer Garten station, the center of West Berlin). The “otherwise usual extensive security measures” could also be dispensed with.[18]

(undated, probably 1965/66). SIEMENS Historical Institute Berlin – Siemensstadt.

**15** Grenz, *Systematische Untersuchung* (cf note 2), 3.

**16** Hildenbrand, *Unterrichts-Reaktor* (cf note 9), 226.

**17** Grenz, *Systematische Untersuchung* (cf note 2), 21.

**18** Ibidem., 14.

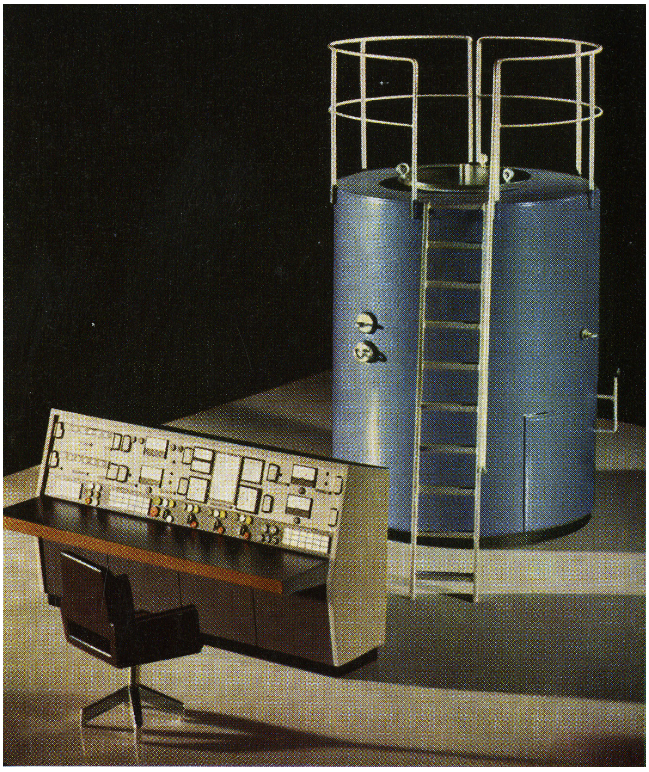

**Figure 1**: Siemens teaching reactor in model. Source: Siemens Historical Institute.

The extremely low power of the SUR-100 is also the main reason why it is not to be spoken of as a research reactor, but as a teaching object. Research reactors could not serve additional educational purposes as they were too expensive to operate and their capabilities had to remain available for scientific experimentation.[19] 13

The SUR-100, on the other hand, was designed from the outset as a training reactor, and thus represented a special feature among European designs. As already mentioned, it was developed as a so-called zero-power reactor, which prospective engineers were able to study within the framework of a practical course within their programmes. Since it was assumed that many graduates would later be more involved with reactor technology in the industry, a reactor had to be built that met the requirements of industry but was constructed in a way that ensured enough space for teaching and use in university buildings.[20] 14

**19** Ibidem.

**20** Ibidem, 7.

15 The moderator fuel plates of the reactor core were surrounded by a graphite reflector. A portion of this reflector on the reactor core was enclosed gas-tight by a reactor vessel. The SUR-100 was shielded with a lead casing. The reactor vessel, which formed the outer structure of the reactor, was filled with an aqueous boric acid solution. The reactor was controlled by two control plates made of cadmium. They were located opposite each other on the reactor vessel. Both the drive for the control plates and the drives for the neutron source and for the core hoist were located below the core. There were five experimental channels and a thermal column located vertically above the core (cf. fig.2). The SUR-100 did not require external cooling. In addition, no contaminated waste was generated by the reactor's operation.[21]

16 A particular advantage of the training at the SUR-100 was that students could qualitatively study the typical behavior of a reactor. They were able to perform the individual operations themselves at the control panel under the supervision of an assistant.[22] Within 20 sessions, students were able to accumulate detailed knowledge on reactor technology through the use of the SUR-100.[23]

17 The following exercises at the SUR-100 were developed and carried out: experiments on beta radiation, gamma absorption, layer thickness measurement, gas flow meter, measurement on a coincidence arrangement, and the detection of neutrons. In addition, so-called start-up exercises, consisting of control rod calibration and neutron flux density distribution in the reactor.[24] The practical course with the SUR-100 was structured in such a way that all aspects could be trained in equal detail and thoroughness.[25] SIEMENS developed a "comprehensive experiment book with theoretical basics and suggestions for practical experiments:

> "According to its structure, the application possibilities of the reactor lie in the field of teaching and training, whereby the reactor (...) itself serves as an object for demonstration and practice, (...) [which is why] the student becomes familiar with the basic structure and operating behavior of reactors by becoming acquainted with and commissioning the reactor".[26]

The reactor also had a central function for diploma and degree theses. For companies, however, it was less interesting which experiments the graduates carried out during their studies, but rather that they had already had contact with reactor technology (the work on the SUR-100 also had nothing in common with work on a research reactor), since many more specific questions could be clarified using a research reactor than could be in experiments using the small teaching reactor. The SUR-100 was not used as a research reactor in the classical sense but had the sole function of bringing young people closer to nuclear technology and training them in reactor safety. The aim was not only to inspire the students to work in the nuclear industry, but also to make them attractive as candidates for industry after graduation.[27] 18

At the Bremen Academy of Engineering, where the tenth SUR-100 was set up in 1967, nuclear technology was a compulsory subject in the training courses for electrical engineers, mechanical engineers, shipbuilders and marine engineers.[28] The SUR-100 was therefore the most important practical and illustrative tool in these fields of study.[29] 19

**21** Untersuchung im Auftrag des Bundesministers für Forschung und Technologie. Förderungskennzeichen 02 S 7021 6: Stilllegung und Beseitigung von Forschungs-, Materialprüf- und Unterrichtsreaktoren. Bericht Nr. 633. Frankfurt: NIS Nuklear-Ingenieur-Service; Abschnitt 6.1.1. von Petrasch, P.; Seidler, M.; Stasch, W. (1983) – Part of the file Bundesarchiv Koblenz, Bestand B/196/160885, Standort 10, Magazin I 3A E.2.03, Reihe 262.
**22** Ibidem., p. 23.
**23** Ibidem., p. 32.
**24** Ibidem, p. 34f.
**25** Ibidem, p. 38.
**26** Hildenbrand, *Unterrichts-Reaktor* (cf note 9), 5.
**27** Grenz, *Systematische Untersuchung* (cf note 2), 8.
**28** On 11 October 1968, the German nuclear energy research ship "Otto Hahn" was put into operation, and its operation was also accompanied by the Bremen University of Applied Sciences.
**29** Alfred Becker, *Kerntechnik in der Ingenieurakademie Bremen. Bremen und seine Ingenieure 1969. Festschrift zur 75-Jahr-Feier der Ingenieurakademie der Freien Hansestadt Bremen* (Bremen: 1969), 111-112.

16

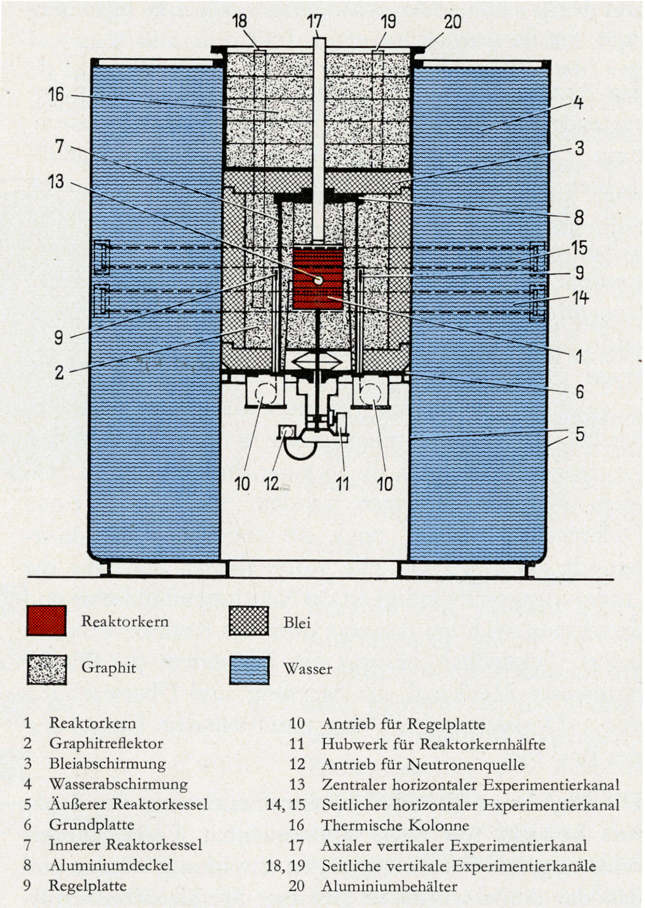


**Figure 2**: Longitudinal section through the Siemens teaching reactor. Source: Siemens Historical Institute.

| **Location** | **Service** | **Commissioning** | **Decommissioning / Dismantling** |
|---|---|---|---|
| RWTH Aachen | 100 mW | 1966 | 2002-2008 |
| TU Berlin | 100 mW | 1963 | 2000-2021 |
| Hochschule Bremen | 100 mW | 1967[30] | 1993-1997 |
| TU Darmstadt[31] | 800 mW[32] | 1963[33] | 1989-1996 |
| HFU Furtwangen | 100 mW | 1973 | In operation[34] |
| TU München | 100 mW | 1961[35] at Garching; 1969 Transfer to the TU[36] | 1981-1998[37] |
| Universidad Nacional Autónome de México[38] | 100 mW | 1972 | |
| Hochschule für Angewandte Wissenschaften Hamburg[39] | 100 mW | 1965[40] | 1999[41] |
| Leibniz-Uni Hannover | 100 mW | 1971 | 2008-2021 |
| Karlsruher Institut für Technologie (KIT) | 100 mW | 1966 | 1997-1999[42] |
| FH Kiel | 100 mW | 1966 | 1997-2008 |
| Universidad Nacional de Rosario (Argentina) | 100 mW | 1971 in Buenos Aires, relocation and start-up in Rosario 1973 | In operation |
| Uni Stuttgart | 100 mW | 1966 | In operation |
| THU Ulm[43] | 100 mW, but can be increased up to 1 W for a short time.[44] | 1965 | In operation[45] |

**Table 1**: Sites of SUR-100.[46]

**30** Renate Meyer-Braun, Ronald Mönch (eds.), *Vom Technikum zur Hochschule Bremen, 100 Jahre Ingenieurausbildung in Bremen* (Bremen: Hausschild, 1994), 120.
**31** Location: Schloßgartenstraße, Bauwerk 18.
**32** Another special feature of the Darmstadt reactor, apart from its higher output, was the lupol granulate filling of the reactor vessel (instead of the aqueous boric acid solution) and an additional concrete shell.
**33** SIEMENS-Unterrichtsreaktor (SUR 100) der TH Darmstadt.- Genehmigungs- und Überwachungsverfahren; Bundesarchiv, BArch B 138/4943: Aktenzeichen: 5531-321.
**34** **https://sftp.hs-furtwangen.de/~neutron/labore.html** retrieved on 15.1.2021.
**35** As a prototype at the SIEMENS-Schuckert-reactor station in Garching.
**36** Letter from SIEMENS to the Bundesministerium für wissenschaftliche Forschung vom 3. Oktober 1969; Bundesarchiv Koblenz, B 196/2785, Unterrichtsreaktor SUR 100 der SIEMENS-Schuckert-Werke AG, Garching.- Übergang der Reaktoren SUR und SAR in das Eigentum des Freistaates Bayern 1969, Aktenzeichen 5531-30, p. 2
**37** In 1989-1991, there were discussions about sending the dismantled reactor to Tunisia. Bundesarchiv Koblenz, B 196/110602. Tunesien.- Verhandlungen der TU München über den Transfer eines SIEMENS-Unterrichtsreaktors SUR-100, 1989 – 1991, Aktenzeichen 9442-9; p. 223.
**38** Desarrollar la produccion de energia nuclear; necesidad inaplazable. Gaceta UNAM (Magazine of the Universidad Nacional Autónome de México), IV (39): June 23, 1972 issue, p. 1f.
**39** Location: Main building of the engineering school, Berliner Tor 21.
**40** **http://www.mp.haw-hamburg.de/ing100/reaktor.html**, retrieved on 15.1.2021.
**41** Video of the demolition of the SUR-100: **https://www.youtube.com/watch?v=dxgjkB4ApjM** retrieved on 15.1.2021.
**42** It is now on display in the Mannheim State Museum of Technology and Labour; Bildstelle Forschungszentrum Karlsruhe 28028, Signatur: 11502: Abtransport des SIEMENS Unterrichtsreaktor (SUR) 100 aus dem Fortbildungszentrum für Technik und Umwelt (FTU) als Abgabe an das Landesmuseum für Technik und Arbeit in Mannheim, 23.02.1999.
**43** Location: Institut für Strahlenmesstechnik, Prittwitzstraße 10.
**44** **https://studium.hs-ulm.de/de/org/ism** retrieved on 15.1.2021.
**45** **https://www.zeit.de/campus/2008/01/ingenieure-uebungsreaktor** retrieved on 15.1.2021.
**46** Untersuchung im Auftrag des Bundesministers für Forschung und Technologie. Förderungskennzeichen 02 S 7021 6: Stilllegung und Beseitigung von Forschungs-, Materialprüf- und Unterrichtsreaktoren. Bericht Nr. 633. Frankfurt: NIS Nuklear-Ingenieur-Service, p. 16 and "Auflistung kerntechnischer Anlagen in der Bundesrepublik Deutschland". Bundesamt für die Sicherheit der nukleare Entsorgung, Part of the file Bundesarchiv Koblenz; B 196/160885 Bandnummer 1. Aktenzeichen 5561-2.

**Figure 3**: SUR-100 displayed at the Landesmuseum für Technik und Arbeit Mannheim (originally from the Forschungszentrum Karlsruhe). © Technoseum]

## THE SUR-100 AS A FORM OF "DEVELOPMENT AID"

20 In June 1967, Department III C 2 of the German Foreign Office considered donating a research reactor to a developing country through the IAEA. In the budget for 1968, 200,000 DM had been budgeted for this purpose. However, it was stipulated that the reactor should not be just a gift, but rather that it should also be used locally for teaching purposes and be available to as many students as possible. In addition, ten scholarships were to be made available, in order to enable foreign students to complete an internship in a German company for three months.[47]

21 Government Director Zelle from the Federal Ministry for Scientific Research then asked SIEMENS whether it would be possible to acquire the SUR-100 as a development aid. SIEMENS offered the Ministry a training reactor with an output of 100 mW for 370,000 DM and recommended that a developing country be selected that would also be interested in nuclear power plants in the future. SIEMENS first suggested Greece or Turkey, since both countries had expressed interest in the SUR-100 in previous years.[48] In the months that followed, discussions were held with SIEMENS to determine which countries might be considered. Romania, Spain, Mexico and Argentina were also considered.[49]

However, the SUR-100 was not exported solely with the altruistic goal of development aid, but rather target countries were deliberately selected on the basis of which governments were hoped to begin their own nuclear programs. 22

After a discussion between Federal Minister Stoltenberg and the Argentine Minister of Economics, the Foreign Office recommended to the Federal Ministry of Scientific Research on November 21, 1967, that Germany give Argentina a SUR-100 and that cooperation in the field of nuclear energy be 23

**47** Note: Stärkung des deutschen Einflusses in der IAEO vom 14. Juni 1967; Bundesarchiv Koblenz; B 138/4753; Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972, Aktenzeichen 9620-21, Organisationseinheit I B 3, Bezugsjahr 1971.

**48** Letter from Dr. Hildenbrand, SIEMENS to Government Director Zelle at Bundesministerium für wissenschaftliche Forschung vom 25. Juli 1967; Bundesarchiv Koblenz; B 138/4753; Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972, Aktenzeichen 9620-21, Organisationseinheit I B 3, Bezugsjahr 1971.

**49** Partial draft "German gift of a teaching reactor", Federal Foreign Office, Division III C 1 / III C2. Bundesarchiv Koblenz; B 138/4753; Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972, Aktenzeichen 9620-21, Organisationseinheit I B 3, Bezugsjahr 1971, p. 546.

expanded.[50] In a letter from the Foreign Office, it is stated that Argentina has a well-developed economic and social structure and has reached a scientific level such that a "fruitful evaluation" of a SUR-100 would be expected and would bring the potential for Argentina to develop its own nuclear projects.[51] The decisive factor, however, was probably the fact that the president of the Argentine Atomic Energy Commission, Admiral Quihillalt, had informed the German minister shortly beforehand that Argentina intended to build its first nuclear power plant near Buenos Aires, and that SIEMENS and AEG would participate in addition to U.S. companies. The Foreign Office hoped that Argentina might decide in favor of German nuclear power plant technology after the donation of the SUR-100.[52] Whether this fact led to SIEMENS actually securing the contract for the construction of the power plant in Argentina in 1968 is unclear.

24 The conditions for the export of the SUR-100 stipulated that physicists from the target countries would come to Germany for "teaching". The means of travel for the physicists were usually handled bilaterally between Germany and the target country.

## MEXICO

25 As a special form of development aid, on May 15, 1969, the Mexican government asked the FRG to export a SIEMENS teaching reactor to Mexico. [53] This was preceded by a study by the Stanford Research Institute, which had concluded that nuclear power plants could be attractive for developing countries such as Mexico.[54] On the German side, SIEMENS and AEG expressed interest in exporting nuclear power plant technology, and merged to form Kraftwerk Union AG (KWU) on April 1, 1969..[55] At the same time, the Mexican Ministry of Foreign Affairs asked whether the Federal Republic could donate a teaching reactor to the Mexican State University within the framework of German technical assistance and send a German expert to complete the job.[56] The ambassador wrote to the German Ministry for Economic Cooperation: "If we succeed in making a breakthrough for German technology in this field in Mexico as well, following our success in Argentina, where we installed the first Latin American power plant reactor, favorable starting points for German exports would be created."[57] The application was approved in July 1969. At that time, SIEMENS had already received an order for a 600 MW nuclear power plant in Mexico, with completion scheduled for 1975. The donation of a SUR-100 to Mexico, the second largest university in Latin America with 45,000 students, was to be carried out within the framework of educational aid, since a project to build up a university was seen as primarily oriented to the teaching effect.[58] Prior to this, it was clarified and contractually agreed to that the future construction of nuclear power plants was an integral part of Mexico's current energy policy and that the main benefit of the SUR-100 was to teach scientists and engineers

**50** Note: Zusammenarbeit auf dem Kernenergiegebiet mit Argentinien, Schenkung eines SIEMENS-Unterrichts-Reaktors SUR 100 vom 18. November 1968; Bundesarchiv Koblenz; B 138/4753; Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972, Aktenzeichen 9620-21, Organisationseinheit I B 3, Bezugsjahr 1971, p. 547.

**51** Note: Geschenk eines SIEMENS-Unterrichtsreaktors an ein Entwicklungsland vom 21. November 1967; Ibidem, p. 552.

**52** Ibidem, p. 556.

**53** La republica federale de Alemania dono un reactor a la UNAM. Gaceta UNAM (Zeitschrift der Universidad Nacional Autónome de México), IV (8): Issue from September, 27th, 1972, p. 1f.

**54** For a detailed study of the history of peaceful nuclear energy use in Mexico, see: Gisela Mateos, & Edna Suárez-Díaz, "Peaceful Atoms in Mexico," in Eden Medina, Ivan da Costa Marques, and Christina Holmes (eds.), *Beyond Imported Magic: Essays on Science, Technology, and Society in Latin America* (Cambridge: MIT Press, 2014).

**55** Project Kernkraftwerk Mexiko. Bundesarchiv Koblenz, B/213/17495, Standort 10, I 4 A 1.2.03, Reihe 116. Bd. 28 T 2032 Mexiko: Förderung des höheren Erziehungswesens.-Lieferung eines Unterrichtsreaktors für die Universität Autonoma de Mexiko

**56** Letter from the German Ambassador to Mexico dated May 28, 1969, Bundesarchiv Koblenz, B/213/17495, Standort 10, I 4 A 1.2.03, Reihe 116.

**57** Ibidem.

**58** Letter from ORR (Chief Regent) Schlüter to RegAss (Government Assessor) Stieler dated July 22, 1969.; Bundesarchiv Koblenz, B/213/17495, Standort 10, I 4 A 1.2.03, Reihe 116.

the process of flow measurement and counting and safety technology.[59] The first offer for the assembly of the SUR-100 in Mexico was 700,000 DM, much higher than for the Argentine reactor. The reactor was scheduled to be shipped from West Germany to Mexico in July 1972. Mexican scientists were invited to the SUR-100 reactors in Karlsruhe, Darmstadt and Hannover for training purposes.[60]

26 The SUR-100 was shipped from Bremen to Mexico on the MS Taifun on July 1, 1972.

27 On September 25, 1972, the reactor was handed over to the Mexican authorities and, after a test phase, went critical.[61] However, the training of nuclear engineers at SUR-100 in Mexico was briefly discontinued as early as 1973, as the expansion of nuclear energy in Mexico was postponed for the time being due to sufficient alternate energy sources.[62]

## ROSARIO, ARGENTINA

28 Argentina was selected as the recipient of a SUR-100 as it was considered to be the leading nation in nuclear technology in Latin America in the late 1960s. Nuclear research initially began in 1957 with a small RA-1 research reactor.[63] The SUR-100 became the fourth reactor in the country (and numbered accordingly: RA-4; cf. fig.3). A first commercial nuclear power plant in Atuca (in operation since 1974) was already under construction when the German ministries considered the donation of a SUR-100 and the order was received by SIEMENS.[64]

29 The delivery of the SUR-100 to Argentina was completely financed by West Germany. After installation at the destination, the Argentine personnel were to be trained by German specialists during a five-day trial operation.[65] The costs of installation and dispatch were also borne by the German side. By December 1969, the SUR-100 intended for Argentina was ready for shipment in Germany. However, the first Argentine personnel to be deployed at the SUR-100 in Rosario had not yet been sent to Germany for training purposes at that time and in July 1970 the reactor was still in Germany. [66]

30 The costs for the Argentines' trip to the FRG were covered by the Fund for Vocational Training and Further Education of Nationals from Developing Countries of the FRG. The stay was planned for six to eight months.[67] As the documents show, it was particularly important to both the German ministries and SIEMENS that the Argentines came to Germany to learn about German reactor technology and meet professional colleagues. The visit of the two reactor technicians for training in Germany was to be planned in such a way that their trip would not end until the SUR-100 arrived in Argentina. On September 22, 1970, SIEMENS finally handed over the reactor to the Federal Minister of Education and Science for a purchase price of 400,000 DM, including "free installation on site within Argentina."[68]

59 Letter from LR I mark 2797 dated October 14, 1969.; Bundesarchiv Koblenz, B 138/4773, Technische Hilfe.- Lieferung eines Reaktors SUR 100 an Mexiko 1969 – 1972, Aktenzeichen 9622-2 I B 4.

60 Letter from the German Foreign Office to the Bundesminister für Bildung und Wissenschaft vom 24. Februar 1971; Bundesarchiv Koblenz, B 138/4773, Technische Hilfe.- Lieferung eines Reaktors SUR 100 an Mexiko 1969 – 1972, Aktenzeichen 9622-2 I B 4.

61 Final Report Projekt 66.2519.8. Lieferung eines Unterrichtsreaktors SUR 100 Nationaluniversität Mexiko. Bundesarchiv Koblenz, B/213/17495, Standort 10, I 4 A 1.2.03, Reihe 116.

62 Note. Förderung des höheren Erziehungswesens in Mexiko; Bundesarchiv Koblenz, B/213/17495, Standort 10, I 4 A 1.2.03, Reihe 116.

63 Carlos Ruben Calabrese (1999). Research reactors in Argentina (INIS-XA-C--028). International Atomic Energy Agency (IAEA).

64 Information from the staff team Oscar Peire, University of Rosario on November 3, 2020.

65 Contract between the FRG, Federal Minister for Scientific Research and the SIEMENS Company dated September 26, 1968; Bundesarchiv Koblenz, B/213/17495, Standort 10, I 4 A 1.2.03, Reihe 116.

66 Letter from Dr. Monnicken to the Foreign Office, Department IIIA, July 31, 1970.; Bundesarchiv Koblenz B 138/4753. Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972; 9620-21 I B 3, Bezugsjahr 1971.

67 Embassy report of October 28, 1969; Bundesarchiv Koblenz, B/213/17495, Standort 10, I 4 A 1.2.03, Reihe 116.

68 Invoice 2484/18 286 of September 22, 1970; Bundesarchiv Koblenz B 138/4753. Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972.


**Figure 4**: The teaching reactor RA-4 at the Instituto de Estudios Nucleares y Radiaciones Ionizantes IENRI. Credits: Ing. Oscar Peire.

31 Admiral Oscar A. Quihillalt, Director of the National Atomic Energy Commission of Argentina, assured the Germans that construction of the reactor building in Rosario would begin in early January 1971 and envisaged a possible reception of the SUR-100 in Argentina in mid-August 1971. However, the construction work in Rosario could not be completed in time. Therefore, when the SUR-100 arrived in South America, it first had to be "temporarily stored" in Buenos Aires for several months. On September 13, 1971, the SUR-100 Aires was critically tested for the first time during a trial run at the interim site Centro Atómico Constituyentes in Buenos Aires.[69] The SUR-100 was not brought to and installed at the University of Rosario until early 1973.[70]

32 The SUR-100 was in operation (under the designation RA-4) until about 1983. Political and economic circumstances meant that nuclear technology was no longer promoted in Argentina. The SUR-100 fell into a slumber and was hardly used as a teaching reactor until the 2010s. When the director who had been in charge of the reactor died, his position was not filled and the reactor was only used by a few students and was only activated once a year.[71] It was not until 2014, when the institute received new management, that the decision was made to breathe new life into the SUR-100. The reactor building was refurbished, safety measures were changed and extensive safety measures were implemented. It is still in operation today.[72]

## DISMANTLING

In 1983, a first report was published concern- 33
ing dismantling research reactors, including the dismantling of the SUR-100 at German universities.[73] The effort of dismantling was comparatively small for the teaching reactors. A volume of 10 Mg had to be removed and only a very small part of it was radioactive (only the steel frame of the lead shielding and the base plate showed radiation). The dismantling could be done within 26 working months, although usually within 4

**69** Letter from the Embassy of the FRG Buenos Aires to the Foreign Office dated September 17, 1971; Bundesarchiv Koblenz B 138/4753. Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972, p. 138.

**70** Letter from the Federal Minister of Education and Science to the Foreign Office, Division III A 7, February 26, 1971; Bundesarchiv Koblenz B 138/4753. Lieferung eines SIEMENS-Unterrichtsreaktors SUR 100 an Argentinien als deutscher Beitrag, 1966 – 1972.

**71** Information from the staff team Oscar Peire, University of Rosario on November 3, 2020.

**72** Ibidem.

**73** Petrasch, Seidler, Stasch, *Stilllegung und Beseitigung* (cf note 21), p. 150.

weeks, and was expected to cost 400,000 DM. After a final inspection of the former reactor room, the control area could be released by the authorities for further use.[74] At the time of the report (1983), twelve SUR-100s were in operation in West Germany.[75]

## DISCUSSION

34 The SUR-100 has also been a kind of "Trojan horse", because the German government did not primarily have development aid in mind when it donated teaching reactors to Latin America but wanted to give SUR-100 reactors primarily to those Latin American countries to which SIEMENS hoped to export its power plant technology. The Federal Republic had copied this approach from the USA, which had pursued precisely this concept years before:

> "The American nuclear policy under the banner of "Atoms for Peace" (itself a response to the failed course of restrictions), on the other hand, wanted to achieve this control through 'cooperation' - namely with highly developed research reactors as the first 'offers' to the respective addressees. This was linked to the expectation that these countries would continue to base their own nuclear development on the American course."[76]

35 With the donation of the SUR-100, the donated countries were also contractually obligated to send their nuclear physicists to Germany for training on the SUR-100 (The stay was paid for by the German government). In addition to familiarizing themselves with the SUR-100, the main purpose of the trip was for the physicists to become acquainted with German reactor technology and to establish contacts with German experts in the field of nuclear power. This made it possible to forge closer economic ties through diplomatic channels. The SUR-100 demonstration and training reactor can thus be seen as a small example of a tool in diplomatic negotiations between Germany and Latin America. The idea that West Germany exported scientific expertise and technical know-how to developing and emerging countries should not be underestimated. Many exchange programs (f.e. 1965-1974 with the Indian Institute of Technology Madras) were about this: "Reducing Soviet influence was arguably the main motivation for the West German engagement."[77] In India, too, the government was primarily concerned with exporting practical experience: "The strong German focus on research and teaching labs reflected continued German insistence on practical engineering education rather than theory."[78]

Acquiring an entire reactor was admittedly the most expensive means of exhibiting German nuclear power technology (if the purchase price and dismantling costs are combined). Within Germany, a large number of prospective engineers from a wide range of technical disciplines not only learned about reactor technology at the SUR-100 but were sensitized to the manageability of nuclear processes through their experimental internships, which led them to choose a career in the nuclear power industry. 36

In particular, the two exports to Mexico and Argentina, described in more detail in the article, which led Latin American countries to choose German reactor technology for the construction of their nuclear power plants is worth highlighting here. 37

In contrast to the other Atomic Exhibition case studies, no political statements were made using the SUR-100 as teaching object. Nevertheless, the SUR-100 played a major role in shaping German nuclear science and policy for two decades. In addition to educating German engineers, it helped, most importantly, with cooperation with Latin America. If engineering students can be considered the broader public, 38

**74** Ibidem.
**75** Ibidem., p. 15
**76** Eckart Michael, "Die Anfänge der Atompolitik in der Bundesrepublik Deutschland", *Vierteljahreshefte für Zeitgeschichte*, vol. 37, n° 1, 1989, 143
**77** Roland Wittje, "Engineering Education in Cold War Diplomacy: India, Germany, and the Establishment of IIT Madras". *Ber. Wissenschaftsgesch.*, vol. 43, 2020, 571.
**78** Ibidem, p. 578.

the SUR-100 also propagated the use of nuclear energy to a larger public audience.

39 In terms of diplomatic negotiation, however, the assessment of the SUR-100 is rather weak. Apart from Argentina, which was given a SUR-100 in 1969 and ordered German power plant technology from SIEMENS for its first nuclear power plant, which went into operation in 1974 (and the SUR-100 is still in operation today, albeit modernized), "development aid with ulterior motives" was not successful in Mexico. Mexico bought U.S. technology for its only nuclear power plant, Central Nuclear Laguna Verde (completed in 1990), for which the first plans were made as early as 1968. Brazil, on the other hand, opted for SIEMENS technology in 1975 for the planning of its first nuclear power plant (Central Nuclear Almirante Álvaro Alberto, opened in 1982) and maintains close technical relations with Germany, although no SUR-100 had previously been given away.

From 1981 to 2008, most of the SUR-100s were shut down (today, only three reactors are still operating in Germany and one in Argentina). University archives today contain little (or no) documentation of this very special type of reactor and diplomatic negotiation in the nuclear field. The purpose of this article is therefore to commemorate this very special type of development assistance. 40

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