

Nuclear Latency (NL) Dataset
Country Coding Sheets

YUGOSLAVIA
COW COUNTRY CODE: 345

List of Country's Enrichment and Reprocessing (ENR) Facilities

1. Vinca Reprocessing Center near Belgrade (Boris Kidric Institute of Nuclear Sciences)
2. Vinca Electromagnetic Isotope Separator (Vinca Laboratory of Physical Chemistry)
3. Rudjer Boskovic Institute
4. Jozef Stefan Institute near Ljubljana

Detailed Facility-Specific Information and Sources

1. Vinca Reprocessing Center near Belgrade (Boris Kidric Institute of Nuclear Sciences)

- a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Reprocessing (four hot cells, and PUREX process).

- b. *Facility size (laboratory, pilot, commercial).*

We are inclined to code this as a laboratory facility. However, a formerly top secret US document indicates that Yugoslavia had a pilot reprocessing plant in 1974. Assuming this is true, the CIA report was likely referring to the Vinca plant.

- c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

The facility started construction in 1956¹ and became operational in 1966.² The facility operated until 1977 or 1978. We use 1978 as the end of operation date.³

- d. *Was the facility developed covertly? If so, identify years that facility was covert.*

Yugoslavia had a secret nuclear weapons program in place during the time that this facility operated. However, the country did not seem to hide its reprocessing-related

¹ The 1956 date is provided by Zentner et al. (2005). However, the start date is disputed. Nakicenovic (1961) uses the 1950's as the starting date for Yugoslavian reprocessing efforts. However, no additional sources use the earlier start date. It is likely that some form of research occurred before the 1966 date, as there are Yugoslavian scientific publications from 1965. However, the location where early research was conducted was not identified.

² SPIRI and Zentner et al. (2005) state 1966 as start of operation.

³ Yugoslavia did not report plutonium separation to the IAEA in 1973, which is a violation of NPT. The IAEA sought more information in 1997 concerning the unreported plutonium separation.

activities. According to one source (Dejan 1997), the work being done was reported in media outlets at the time.

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

Unreported plutonium research allegedly occurred prior to signing the NPT. The facility was placed under IAEA safeguards in the late 1970s. However, the facility was not under IAEA safeguards during the time that the reprocessing activities occurred.

- f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

- g. *Did the facility have a military purpose?*

Yes, the spent fuel reprocessing was for plutonium extraction for the nuclear weapons program.

- h. *Was the facility multinational? If so, identify the other countries that were involved.*

No.

- i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

Yes. It is generally reported that Norway and Czechoslovakia assisted in the creation of the reprocessing facility at Vinca. While it is known there were scientific exchanges and that joint research was conducted among scientists from Norway and Yugoslavia, evidence regarding the actual construction of the reprocessing plant at Vinca is less prolific. Letters between Norwegian and Yugoslav officials show that Yugoslavia requested Norwegian assistance in the construction of the reprocessing plant, and an agreement was reached with the Norwegian company Noratom to build a reprocessing laboratory at Vinca based on the Kjeller plant. Though these plans never came to fruition, the engineering blueprints for the plant were delivered to Yugoslavia in 1962. By 1966 a laboratory scale Purex reprocessing plant with four hot cells was operational at Vinca. It is reported that both Norway and Czechoslovakia assisted in this plant. Norway is listed as providing assistance but there is insufficient evidence that Czechoslovakia provided state sanctioned support.⁴

- j. *Sources:*

⁴ The facility at Vinca received unspecified technical assistance from Czechoslovakia (Koch 1997, 124 cites Katz and Marwah 1982, 346). A review of Katz and Marwah does not include Czechoslovakian assistance, however. Further evidence must be found of Czechoslovakian assistance for inclusion in the dataset.

- Anastasijevic, Dejan. 1997. "Belgrade on Barrel of Uranium." *Vreme*, March 15: 23-25.
- Katz, James Everett and Onkar S. Marwah. 1982. *Nuclear Power in Developing Countries*. Lexington, MA: Lexington Books.
- Koch, Andrew. 1997. "Yugoslavia's Nuclear Legacy: Should We Worry?" *The Nonproliferation Review*. Spring/Summer.
- Hibbs, Mark. 2001. "Yugoslavia to Re-join IAEA, Vinca Problems Addressed Soon." *Nucleonics Week*. 42(12): 6.
- Hibbs, Mark. 1997. "IAEA To Probe Serbian Regime On Data Showing Pu Separation." *Nucleonics Week*. 38(9): 7.
- Nakicenovic, Slobodan. 1961. *Nuclear Energy in Yugoslavia*. Belgrade: Export Press. 29.
- Nuclear Threat Initiative. 2014. "Hot Laboratory." <http://www.nti.org/facilities/513/>. Accessed 07/13/2015.
- Nuclear Threat Initiative. 2008. "Yugoslavia Nuclear Chronology." http://www.nti.org/media/pdfs/yugoslavia_nuclear.pdf?_=1316466791. Accessed 07/13/2015.
- Stockholm International Peace Research Institute (SIPRI). "Serbia and Montenegro Country Profile: Past Nuclear Policies." <http://archives.sipri.org/contents/expcon/cnsc2yug.html>.
- Stockholm International Peace Research Institute (SIPRI). "Serbia and Montenegro Country Profile: Nuclear Facilities Profile." <http://archives.sipri.org/contents/expcon/cnsc3yug.html>.
- Potter, William C., Djuro Miljanic and Ivo Slaus. 2000. "Tito's Nuclear Legacy." *Bulletin of the Atomic Scientists*. 56(2): 63-70
- Zentner, M.D., G.L. Coles, and R.J. Talbert. 2005. "Nuclear Proliferation Technology Trends Analysis." Pacific Northwest National Laboratory. Report 14480.

2. Vinca Electromagnetic Isotope Separator (Vinca Laboratory of Physical Chemistry)

- a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Enrichment: EMIS.

- b. *Facility size (laboratory, pilot, commercial).*

Laboratory.

- c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

There is very little information about the EMIS-related activities at Vinca. Construction at the facility likely began in 1956.⁵ The facility was in operation during the 1960s but did not result in the production of HEU. Additionally, Yugoslavia moved away from nuclear weapons during the late 1960s, which likely resulted in the end of ENR activity. Our best guess is that EMIS-related activities ended at this site in 1970.

- d. *Was the facility developed covertly? If so, identify years that facility was covert.*

Yugoslavia had a secret nuclear weapons program in place during the time that this facility was constructed. However, it is unclear whether this plant was initially built covertly. We do not code it as a secret facility, but there is some uncertainty about this.

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

No.

- f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

- g. *Did the facility have a military purpose?*

Yes, the research laboratories were part of the nuclear weapons track.

- h. *Was the facility multinational? If so, identify the other countries that were involved.*

No.

- i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

No evidence was found indicating there was foreign nuclear assistance, despite close relations with Norway and Czechoslovakia. The Laboratory of Physical Chemistry was apparently one of the original components when Vinca was built in 1948. The

⁵ This date is the date used for other Yugoslavian facilities in the Vinca complex. The exact construction year was not identified.

Nuclear Threat Initiative notes that much of Yugoslavia's early nuclear work (prior to the 1950s) was carried out indigenously.

j. Sources:

Anastasijevic, Dejan. 1997. "Belgrade on Barrel of Uranium." *Vreme*, March 15: 23-25.

Koch, Andrew. 1997. "Yugoslavia's Nuclear Legacy: Should We Worry?" *The Nonproliferation Review*. Spring/Summer.

Kidric, B. 1965. "Multi-ion Source Electromagnetic Isotope Separator." *Nuclear Instruments and Methods*. 40(2): 309-317.

Nuclear Threat Initiative. 2014. "Department of Physical Chemistry." <http://www.nti.org/facilities/517/>. Accessed 07/13/2015.

Nuclear Threat Initiative. 2014. "Electromagnetic Isotope Separator." <http://www.nti.org/facilities/503/>. Accessed 07/13/2015.

Nuclear Threat Initiative. 2015. "Former Yugoslavia." <http://www.nti.org/country-profiles/former-yugoslavia/nuclear/>. Accessed 07/13/2015.

Potter, William C., Djuro Miljanic and Ivo Slaus. 2000. "Tito's Nuclear Legacy." *Bulletin of the Atomic Scientists*. 56(2): 63-70

3. Rudjer Boskovic Institute

a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Enrichment, EMIS.

b. *Facility size (laboratory, pilot, commercial).*

Laboratory.

c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

The construction of the cyclotron began in 1952 and the facility began operating around 1954. The facility continues to conduct non-enrichment based research. The facility may have ended enrichment operations in 1977, although there is considerable uncertainty about this end date. The facility now operates as a medical isotope production site.

d. *Was the facility developed covertly? If so, identify years that facility was covert.*

Yugoslavia had a secret nuclear weapons program in place during the time that this facility was constructed. However, it is unclear whether this plant was initially built covertly. We do not code it as a secret facility, but there is some uncertainty about this.

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

Not during the relevant era. However, Croatian facilities were placed under safeguards in 1995. The additional protocol agreement was signed in 2000.

- f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

No.

- g. *Did the facility have a military purpose?*

The initial operation of the facility was for military purposes.

- h. *Was the facility multinational? If so, identify the other countries that were involved.*

No.

- i. *Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.*

No. There is no indication that critical, sensitive assistance was provided. It is known that there was a close relationship with Norway at the time (and also with Switzerland and Czechoslovakia), but there is no indication that there was foreign assistance besides training and intellectual cooperation. Additionally, the Rudjer Boskovic Institute claims the cyclotron was “built entirely by institute personnel with support from Croatian industry.”

- j. *Sources:*

Koch, Andrew. 1997. “Yugoslavia’s Nuclear Legacy: Should We Worry?” *The Nonproliferation Review*. Spring/Summer.

Nuclear Threat Initiative. 2014. “Ruder Boskovic Institute.” <http://www.nti.org/facilities/541/>. Accessed 07/13/2015.

Potter, William C., Djuro Miljanic and Ivo Slaus. 2000. “Tito’s Nuclear Legacy.” *Bulletin of the Atomic Scientists*. 56(2): 63-70

Rudjer Boskovic Institute. 2013. "History." <http://www.irb.hr/eng/About-the-RBI/History>. Accessed 07/13/2015.

Stanic, Nade. 1983. "Yugoslavia Ponders Fuel Cycle Development; Blueprint Expected Some Time Next Year." *Nuclear Fuel*. 8(23): 15.

4. Jozef Stefan Institute near Ljubljana

- a. *ENR type (diffusion, centrifuge, EMIS, chemical and ion exchange, aerodynamic isotope separation, reprocessing).*

Reprocessing.

- b. *Facility size (laboratory, pilot, commercial).*

Laboratory.

- c. *Is the facility under construction or in operation? If under construction, list the construction years. If in operation, list the years of operation.*

Construction probably started in 1949. Vinca established its plutonium separation facility in 1954. Tito shut down Yugoslavia's nuclear weapons program in the early 1960s, but reconstituted it in 1974 following India's nuclear test. The publication detailing chemical extraction of plutonium from Jozef Stefan was published in 1976. The facility likely ended separation activities in 1977.

- d. *Was the facility developed covertly? If so, identify years that facility was covert.*

Yugoslavia had a secret nuclear weapons program in place during the time that this facility operated. However, the country did not seem to hide its reprocessing-related activities. According to one source (Dejan 1997), the work being done was reported in media outlets at the time.

- e. *Was the facility placed under IAEA safeguards? If so, identify the years that the facility was safeguarded.*

The facility was not under IAEA safeguards during the time that the reprocessing activities occurred.

- f. *Was the facility placed under regional safeguards? If so, identify the years that the facility was under regional safeguards.*

Not prior to 1977. However, all Slovenian nuclear facilities were under Euratom agreements from 2004 forward.

- g. *Did the facility have a military purpose?*

Under Tito, Yugoslavia developed Track A for the military and Track B for the civilian uses of nuclear technology. Track B was intended to provide the material for Track A. We code this as a military facility.

h. Was the facility multinational? If so, identify the other countries that were involved.

No.

i. Was the facility built with foreign assistance? If so, list the supplier(s) and what they provided.

The United States provided equipment for a “hot laboratory” to separate plutonium on a laboratory scale.

j. Sources:

Boris Kidric Institute of Nuclear Sciences. “Brochure.” 356.

International Atomic Energy Agency. “Slovenia, Republic of.”
<http://ola.iaea.org/factSheets/CountryDetails.asp?country=SI>.

Hymans, Jacques. 2011. “Proliferation Implications of Civil Nuclear Cooperation: Theory and a Case Study of Tito's Yugoslavia,” *Security Studies* 20: 73-104.

Koch, Andrew. 1997. “Yugoslavia’s Nuclear Legacy: Should We Worry?” *The Nonproliferation Review*. Spring/Summer.

Nichol, James P. and Gordon L. McDaniel. 1982. “Yugoslavia.” *Nuclear Power in Developing Countries*. Edited by James Everett Katz and Onkar S. Marwah. Lexington, MA: Lexington Books.

Nuclear Threat Initiative. 2014. “Josef Stefan Institute.” Nuclear Threat Initiative.
<http://www.nti.org/facilities/535/>. Accessed 07/13/2015.

Nuclear Threat Initiative. 2008. “Yugoslavia Nuclear Chronology.”
http://www.nti.org/media/pdfs/yugoslavia_nuclear.pdf?_id=1316466791. Accessed 07/13/2015.

Potter, William C., Djuro Miljanic and Ivo Slaus. 2000. “Tito’s Nuclear Legacy.” *Bulletin of the Atomic Scientists*. 56(2): 63-70

Republic of Slovenia: Ministry of Agriculture and the Environment. “Research Reactor Trigra Mark II with Hot Cell.”
http://www.ursjv.gov.si/en/nuclear_and_radiation_facilities/research_reactor_trigra_mark_ii_with_hot_cell/. Accessed 07/13/2015.

Additional Note:

Laser isotope separation and ion exchange may have occurred at Vinca. Koch and SIPRI list each form of enrichment but provide no further details. Both references are based on a brochure produced by the Boris Kidric institute of Nuclear Sciences. The references for laser and ion exchange are currently not sufficient to be included in the dataset.