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## **Jaap Kistemaker en uraniumverrijking in Nederland 1945-1962**

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### **Citation**

Streefland, A. H. (2017, September 20). *Jaap Kistemaker en uraniumverrijking in Nederland 1945-1962*. Retrieved from <https://hdl.handle.net/1887/52965>

Version: Not Applicable (or Unknown)

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**Issue Date:** 2017-09-20

## SUMMARY

### Jaap Kistemaker and uranium enrichment in the Netherlands 1945-1962

This book describes the history of uranium enrichment in the Netherlands in the period 1945-1962. The main protagonist is Jaap Kistemaker, the Dutch pioneer of isotope separation. This book is not a biography of Kistemaker. Instead, by following Kistemaker, it describes a crucial period in the history of uranium enrichment, namely the prehistory of the English-German-Dutch cooperation that led to the founding of the industrial firm Urenco. From a broader perspective, this study shows how science underwent a change towards a more industrially inclined, validatable and large-scale endeavor. Technology and science intertwined – legitimizing a term like technoscience.

Directly after the end of the second World War, the Dutch physicist Jaap Kistemaker started researching the possibilities of uranium enrichment. He was appointed by the Foundation for Fundamental Research of Matter (*Stichting voor Fundamenteel Onderzoek der Materie*, FOM). Under supervision of Cornelis Bakker, Kistemaker built a large electromagnetic isotope separator with which small samples of uranium could be enriched. To build the machine, he cooperated with local industries like Werkspoor Amsterdam. In November 1953, he presented the first enriched uranium to FOM.

Kistemaker was the first director of the FOM Laboratory for Mass

Separation in Amsterdam (later called AMOLF). This institution steadily grew from a small-scale institute to a self-sufficient research laboratory. In 1955, Kistemaker got interested in ultracentrifuges: fast spinning cylinders with which uranium isotopes could be separated. The research on ultracentrifuges was mainly based on trial and error. The first experiments were conducted in a shelter on the terrain of Werkspoor. The Dutch Reactor Institute (*Reactor Centrum Nederland*, RCN) supported the centrifuge research financially.

In 1957 Kistemaker organized an international symposium on isotope separation. At this event, he was approached by Gernot Zippe, an Austrian physicist who had worked as a prisoner of war on ultracentrifuges in the Soviet Union. He revealed to Kistemaker that ultracentrifuges would be more efficient if they were based on the principle of the spinning top: lightweight centrifuges that spin in vacuum with the least possible friction. Kistemaker quickly decided to focus his research on this kind of centrifuges. Subsequent attempts to get information from Zippe failed because Zippe had found a job at the German firm Degussa. He was not allowed to share knowledge with Kistemaker.

Within the European framework of Euratom, plans were made to invest in the enrichment of uranium. Although the French wanted to build a diffusion plant, the *Syndicat d'Etudes pour la construction de l'Usine Européenne de Séparation de l'Uranium* decided it best to wait till the ultracentrifuge technology was further developed. Euratom did not invest in a European uranium enrichment plant.

In the period from 1957 till 1960 the Dutch centrifuge program was confronted with bureaucratic demands and financial cutbacks. The project nevertheless grew. Attempts were made to form an alliance with German centrifuge groups, but these failed.

In 1960 Kistemaker's centrifuge project underwent major changes. An American delegation requested the Dutch government to formally classify the centrifuge project. The background for this was not only that knowledge of centrifuges should be contained for security reasons, but also that the US wanted to keep control over

the Dutch project. The Dutch government consented with the American request and classified the project. This had implications for the way Kistemaker could conduct his research.

In the same year, a commission evaluated the project and concluded that it seemed a very promising endeavor. The commission recommended the government to evaluate the project further, which happened in 1961 and 1962. Again, it was concluded that the project was promising enough to keep investing in the project.

In July 1962 Kistemaker resigned as the leader of the project. He and his close collaborator Joop Los stayed on as advisers of the project. In 1971 the Treaty of Almelo was signed by the UK, Germany and the Netherlands. This treaty laid the foundation for the nuclear fuel corporation Urenco.