# Building an Industrial Identity

*Atlas of Architectural and Cultural Values of Hydropower Plants and Communities of the River Oulujoki Water System*

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*Cover photo: Pekka Elomaa - Montta hydropower plant, Vaala, designed by Aarve Ervi, © Council of Oulu Region*

*Back cover: The guesthouse of Leppiniemi.*
*Photo: Foto Roos © Fortum Power and Heat.*

# Contents

# 1. Introduction

*Building an industrial identity – Atlas of Architectural and Cultural Values of Hydropower Plants and Communities in the Oulujoki Water System* is a publication by the Council of Oulu Region. It functions as a source of information and as a report and directive for anyone interested in the architecture and/or the cultural heritage of the Oulujoki water system. This atlas was written as a part of Vesivoiman kulttuuriperintö (VekuVaku) project.

Vesivoiman kulttuuriperintö/Vattenkrafts kulturarv (VekuVaku) translates as the Cultural Heritage of Hydropower. This is a cross-border project executed by Finnish and Swedish parties during 2019–2022. This atlas was written between January of 2021 and April of 2022. Although VekuVaku is a cross-border project, this atlas focuses on Finland and the water system of the River Oulujoki.

The hydroelectric power plants along the watercourses of the River Oulujoki, stand as one of the largest single construction projects in the post-war reconstruction of Finland. It is also one of the most significant and coherent pieces of industrial architecture in the country. The power plants and the residential areas connected to them were built in the middle of wilderness using methods of modern architecture and engineering.

This chain of power plants cover a large area that spans over two administrative districts: northern Ostrobothnia and the Kainuu region. The power plants are divided over four rivers: the Oulujoki, Kiehimäjoki, Emäjoki and the Ontojoki in the east. Four of the power plants are located in city centres. The City of Kajaani has two older power plants that date back to the beginning of the century. There is also one newer power plant in Kajaani built in 1995 but the actual body of these power plants was built between 1939 and 1963.

Harnessing these northern rivers, was a brave venture, with its optimism and unwavering faith in the possibilities of modern technology It tels a story of a war-torn country in the middle of modernization. It also tells a lot about the zeitgeist of the era. Today, this built heritage, that has preserved well, is also a testament of the creativity and work ethic of the architects and engineers as well as the actual builders.[1]

The power plants were built out of necessity after Finland lost majority of its hydropower in the Second World War and had to pay heavy war reparations. The country was also in the midst of industrialization and needed electricity for its factories. Majority of the power plants was designed by Aarne Ervi (1910-1977) and his office. Ervi was without a doubt one off the most important post war architects in Finland.

This atlas also tries to answer questions and illuminate the possibilities of adding the hydropower architecture of River Oulujoki water system to the UNESCO World Heritage List. This is a subject that is treated more specifically in chapter 1.6 and in chapter six.

1 Huhmo 2017, 3)

The parties implementing the project are Council of Oulu Region and Norbotten Region with Council of Oulu Region acting as the main implementer.

The project is a part of Eu Interreg Nord Programme, co-financed by Regional Council of Lapland and executed in cooperation with Regional Council of Kainuu, Finnish Museum of Architecture, University of Oulu, regional museums of Norbotten, Kainuu and Northern Ostrobothnia, regional power companies (Oulun Energia, Fortum Power and Heat, Kainuun Voima Oy, Loiste Oy, UPM-Kymmene Oyj, Vattenfall), Kainuun Nuotta ry, Metsähallitus, Rokua UNESCO Global Geopark, VisitFinland, village- and home region associations and municipalities in the waterways, their high schools and academies.

This atlas was written by Samuli Paitsola, the building researcher of the project, with the assist of Pekka Elomaa, the project leader. The photographs in this publication have been taken by Elomaa, Paitsola, regional architect Kirsti Reskalenko, or are from an archive. The layout has been created by the Swedish partner and more specifically their building researcher Evelina Regenius Jouper. The project leader for the Swedish side is Marcus Bengtson.

The VEKUVAKU -project's main goal is to identify the values that the residents and actors in the area can utilise today and in the future. With this achieved, the cultural heritage is brought to life and the conditions for conservation and protection are improved. This is achieved through three sub-goals:

**Sub goal 1**

To map out the historical and contemporary values of the power plant architecture and residential areas of the rivers Ule- and Lule. This will broaden and preserve the knowledge of the culturalhistory of the area. The project creates a common concept for the inventory and measurement of power plants, community structure and residential areas.

The project produces a model to address and facilitate everyday issues pertaining to culturally and historically valuable buildings and environments. The project also produces inventory material and recommendations for the care and maintenance that will be made available to property owners, residents, associations, museums, tourism entrepreneurs, energy companies and authorities.

**Sub goal 2**

To strengthen and maintain local and regional communities alive. This will create new opportunities for businesses, support and create new communities and cohesion through information, collaborations and meetings. This is achieved through workshops with village associations and schools, which are adapted for each power plant site, but based on a common model.

The project plans to organise meetings with village associations, introducing issues such as cross border cooperation, history and identity. The project will also raise awareness of questions related to the everyday lives of local residents and entrepreneurs. Local stories will also be collected and archived.

Information will ne disseminated concerning the care and maintenance of the facilities and buildings. A discussion will be held on changes and adaptations for future conservation.
The project will also collaborate with upper-secondary schools, which play a major role in narrating and producing cultural heritage. This collaboration can also contribute to creating a cultural context in the local communities. The project also creates a tourism concept for both rivers that is published on the projects webpage. Meetings on cross-border cooperation will also be arranged if possible.

**Sub goals 3**

The third sub-goal is to increase the visibility of the modern cultural heritage of the northern rivers in various medias and to make relevant information available. This will involve collecting information, disseminating it and sharing it on the projects webpage in four languages (Finnish, Swedish, English and Northern Sami). Information will be also be communicated through mobile applications and social media. A data platform will ne created for museums and other cultural and tourism actors.

## Administration and organization

**The main project leader is the Council of the Oulu Region. The Norrbotten region acts as the project manager for the Swedish party. The cost estimate for the three-year project is €994 677., of which €645 151. comes from Interreg Nord.**

## Structure of the work

**The first chapter** serves an introduction and it provides general information on this publication and on the VekuVaku project by highlighting the background of the work, the methods adopted and by including a list of essential words and hydropower terminology. Chapter 1.3 provides general information on the geographical area and 1.4 reviews the architects and designers responsible for the design work. Chapter 1.5 presents information about the power companies that built the power plants and housing areas and 1.6 highlights the case for UNESCO World Heritage List.

**Chapter 2** is a historical survey of how hydropower has been utilised in the water system.

**Chapter 3** contains a chart of the power plant sites.

**Chapter 4** presents a typology of the buildings built in the housing areas. This is important because the architects involved in the design process used standardisation as a design method. This applies particularly to Aarne Ervi, who used standardised houses and parts in all of the communities he designed. He later adopted the same means and methods when working in Finnish Institute of Standardisation.

**Chapter 5** is a comprehensive review of each individual power plant site. Each section of the chapter will include detailed information on the power plant and the residential area related to it. This chapter will focus on the architecture, its authenticity and originality. It will also include a description of the building's condition and the surrounding environment.

**Chapter 6** presents the results, analysis and evaluation.

**Chapter 7** provides the references and attachments.

## Previous studies

The Oulujoki power company, which has been responsible for harnessing the rivers Oulujoki and Emäjoki, documented the cultural heritage that was lost during the process. The company produced a book titled Entinen Oulujoki (1954), (The River Oulujoki of the Past). Local museums, such as the Pyhäkoski Power Plant Museum and Turkansaari Outdoor Museum, also house many artefacts and buildings in their collections that relate to the river.

In 1991,a historical account of the River Oulujoki Valley was published under the Finnish title *Oulujokilaakson historia* (The History of River Oulujoki Valley). The same year marked the release of an anniversary book by the Oulujoki Power Company under the Finnish title *50-vuotta voimaa koskesta* (Fifty years of hydropower from the rapids).

A more recent project titled Ervi Oulujoella (Ervi on the River Oulujoki) was carried out in 2005–2006 by the architect Helena Hirviniemi. Her focus was on the architecture of the water system. This project also produced instructions for the restoration and maintenance of the buildings.

In 2016, the Council of the Oulu Region conducted an inventory of the regionally valuable built cultural environment. The inventory also included buildings from the River Oulujoki.

In 2017, architect Veli-Pekka Huhmo produced a preliminary study on the World Heritage values of the River Oulujoki Water System.

*The Jylhämä hydropower plant, east façade.*
*Picture: Pekka Elomaa © Council Of Oulu Region*

# 1.1 Methods and Materials

Several methods were used during the project. These include field research, archival and historical research, photography, and structured observation. During field work, the inventory method was adopted to record information and a form was also created for the project.

The material for this atlas was gathered during the fieldwork period of 2019–2020. Elomaa and Paitsola have consulted and used archive material from the archives of the power companies.

## Inventory method

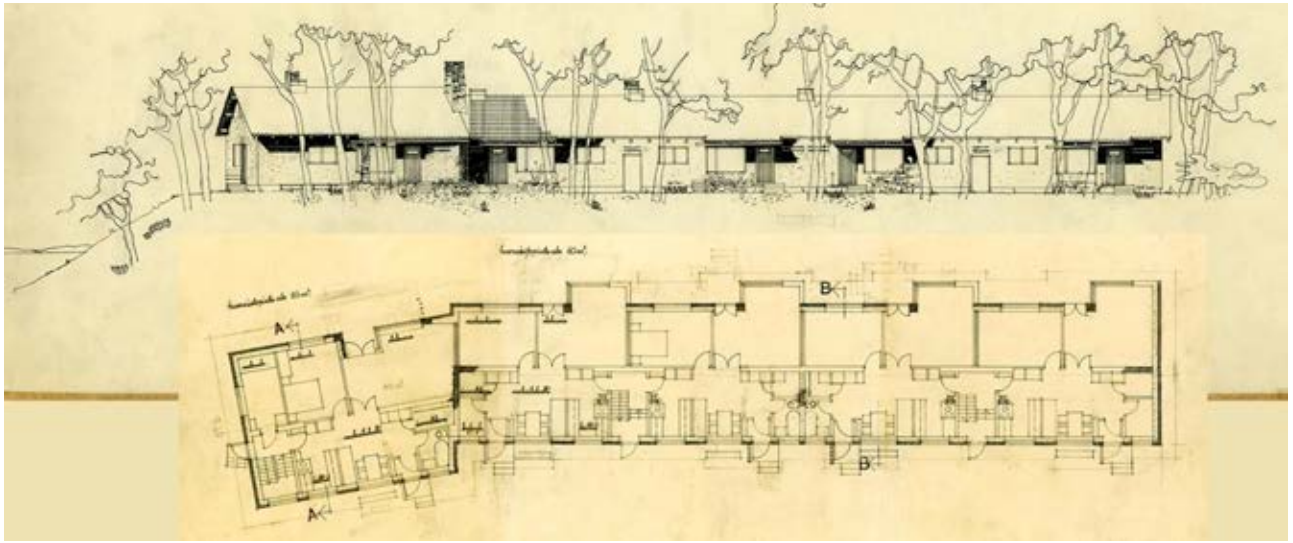
The inventory method for the project was designed to provide a framework for the inventory and to emphasise the type of information that would be vital for the project. The inventory was compiled through structured observation and photography. The information collected from the site was recorded in the inventory form and then digitised to KIOSKI 2.0. KIOSKI 2.0 is a GIS (geographic information system) designed to manage and store information on cultural environments.

The inventory for the power plants was compiled externally as well as internally. Meanwhile, the inventory for the residential areas focussed on the exteriors. This was because the houses were privately owned and further because it would have been impossible to visit all the buildings in the time reserved for the inventory.

The project leader, Pekka Elomaa, visited all the sites during 2019. He compiled the inventory for the power plants and photographed the housing areas. The building researcher for this project, Samuli Paitsola, visited all the housing areas, except Pyhännänkoski and Leppikoski, in 2020 and prepared the inventory. To complete the inventory, Paitsola visited Pyhännänkoski and Leppikoski in 2021.

## Original drawings of Aarne Ervi

In the summer of 2020, while compiling the inventory for the housing community of the Nuojua power plant in the municipality of Vaala, Samuli Paitsola also discovered the original drawings for the area by Finnish architect Aarne Ervi. These drawings were stored in the basement of one of the houses. Fortunately, the owner of the house, Aappo Laitinen, and the board of the housing management company were sufficiently generous and donated the drawings to the project. Understanding the importance of the find, project leader Pekka Elomaa contacted the Museum of Finnish Architecture. The museum was delighted with the discovery. The museum archive already houses a comprehensive Ervi collection and the drawings will be a welcomed addition. Later, similar discoveries were made in the residential areas of Seitenoikea, Montta and Pyhäkoski. All of these drawings will be transferred to the museum archive in Helsinki in 2022. During 2020, more drawings were found. In January of 2021, eight boxes of drawings were retrieved from the archives of the Vaala municipality. Those drawings were also donated to the project but unfortunately they contained only copies and no original drawings.




*Ervi, row house at Nuojua residential area, southeast elevation and ground plan. © Fortum Power and Heat.*

# 1.2 Key Concepts and Essential Vocabulary

## Key concepts

Cultural heritage:

*"Cultural heritage often brings to mind artifacts (paintings, drawings, prints, mosaics, sculptures), historical monuments and buildings, as well as archaeological sites. But the concept of cultural heritage is even wider than that, and has gradually grown to include all evidence of human creativity and expression: photographs, documents, books and manuscripts, and instruments, etc. either as individual objects or as collections. Today, towns, underwater heritage, and the natural environment are also considered part of cultural heritage since communities identify themselves with the natural landscape."*

*"Moreover, cultural heritage is not only limited to material objects that we can see and touch. It also consists of immaterial elements: traditions, oral history, performing arts, social practices, traditional craftsmanship, representations, rituals, knowledge and skills transmitted from generation to generation within a community."*[1]

As is apparent from the citation above, cultural heritage is a concept that is multidimensional and complex and it has been discussed extensively in the past years. Traditionally, only tangible objects have been considered to be part of cultural heritage. However, in the past years, this concept has diversified and today it also includes the intangible part of human culture.

UNESCO also divides cultural heritage into tangible and intangible:

Tangible cultural heritage: movable cultural heritage (paintings, sculptures, coins, manuscripts), immovable cultural heritage (monuments, archaeological sites, and so on), underwater cultural heritage (shipwrecks, underwater ruins and cities)

Intangible cultural heritage: oral traditions, performing arts, rituals.[2]

ICOM Finland (International Council of Museums) defines cultural heritage as follows: cultural heritage includes artefacts and phenomena, tangible or intangible (ICOM Finland)

The most important concept in the World Heritage agreement is that of "outstanding universal value" (OUV): "Outstanding" indicates that the site is unique in global perspective and " universal" signifies that it is meaningful for all people in the world.[3]

Authenticity: authenticity measures how well the site conveys potential outstanding universal value as well as its attributes. Authenticity only applies to cultural properties and to the cultural aspects of "mixed" properties.[4]

Integrity: Integrity measures the comprehensiveness of the Outstanding Universal Values of the site. It also tells how well the site has preserved.[5]

UNESCO defines integrity as follows: "Integrity is a measure of the completeness or intactness of the attributes that convey Outstanding Universal Value." Accordingly, a clear understanding of the potential Outstanding Universal Value is required before it is possible to consider the integrity of the property.

*1 Khan Academy*
*https://www.khanacademy.org/humanities/special-topics-art-history/arches-at-risk-cultural-heritage-education-series/arches-beginners-guide/a/what-is-cultural-heritage*

*2 UNESCO*
*http://www.unesco.org/new/en/culture/themes/illicit-trafficking-of-cultural-property/unesco-database-of-national-cultural-heritage-laws/frequently-asked-questions/definition-of-the-cultural-heritage/*
*3 Huhmo 2017, 10*

*4 Preparing Wold Heritage Nominations (Second edition, 2011) 2011, 62*
*5 Huhmo 2017, 11*

## Essential vocabulary

Authenticity = Autenttisuus, katso tarkempi määritelmä ”Key Concepts” -osiosta

Balloon frame = Rankorakenne

Brick = Tiili

Board and batten cladding = Saumarimoitus, saumarimalaudoitus

Buttress dam = Lamellipato, ripapato

Canal, Channel = Kanava

Cladding = Verhous, vuoraus

Concrete = Betoni

Control gate = Koneistoluukku, jolla kontrolloidaan veden virtausta turbiineihin. Voi olla myös sektoriluukku.

Coupling machinery = kytkinkoneisto/kytkinkenttä

Dam = Pato

Detailed plan = Asemakaava

District plan = Osayleiskaava

Draft tube = Imuputki, vesi johdetaan turbiineista alakanavaan imuputkien kautta

Earthworks = Maarakennus

Embankment = Maapato

Envelope = Rakennuksen lämpöä eristävä vaippa

Fibre-reinforced cement board = Kuitusementtilevy

Forebay = Patoallas eli heti padon yläpuolella oleva vesiallas.

Girder crane = palkkinosturi

Head = Pudotuskorkeus

Headrace = Yläkanava

Headwater = Voimalaitoksen yläpuolella oleva vesi.

Hearth = Tulisija, takka

High voltage trasmission line = Koneaseman kytkinlinjasto

Hydropower, hydroelectricity = Vesivoima, vesivoimalla tuotettu sähkö.

Impoundment = Mikä vaan padon muodostama vesiallas. Teknisempi ilmaus termille ”reservoir”.

Integrity = Eheys, katso tarkempi määritelmä ”Key concepts” -osiosta.

Lake = Järvi

Log chute/logway = Uittokouru

Master plan = Yleiskaava

Outstanding Univesal Value = Poikkeuksellinen yleismaailmallinen arvo, katso tarkempi määritelmä ”Key concepts” -osiosta.

Panel, element = ValmiselementtiPenstock = Tuloputki, jolla vesi johdetaan koneasemaan

Plaster= Rappaus

Powerhouse = Koneasema eli rakennus jossa turbiinit ja generaattorit sijaitsevat.

Power plant, power station = Voimalaitos

Rapids = Koski

Regulating dam = säännöstelypato

Reservoir = Tekojärvi, tekoallas, allas, vesisäiliö, patoallas, säännöstelyallas. Sama kuin ”impoundment” mutta yleisemmin käytetty.

River = Joki

River branch, fork of river = Joen haara, sivuhaara.

RKY = Nationally significant build cultural environment.

Slab = Laatta

Slide gate = Settiaukko

Sluice = Laskukanava joka on mahdollista sulkea sulkuluukulla

Sluice gate = Sulkuluukku

Spillway = Yleensä säännöstelypadossa oleva juoksutusaukko

Spillway gate = Juoksutusaukossa oleva juoksutusluukku

Switchyard = Kytkinkenttä, sijaitsee voimalaitoksen vieressä

Tailrace = Alakanava

Tailwater = Voimalaitoksen alapuolella oleva vesi.

Tainter gate, radial gate = Sektoriluukku

Trash rack = Välppä

Tributary = Sivujoki

Ungated spillway = Juoksutusaukko ilman tulvaluukkua

Water system, body of water = Vesistö

Weir = pohjapato

Sources:

Euroopan Unionin termistöhaku:
*https://iate.europa.eu/home*

Yhdysvaltain hallituksen vesivoima -termistöä:
*https://www.energy.gov/eere/water/glossary-hydropower-terms*

Suomen Ympäristökeskuksen ja Kielitieteen laitoksen ympäristösanastoa:
*https://mot.kielikone.fi/mot/endic/netmot.exe?UI=fied&height=165*

# 1.3 The River Oulujoki Water System

*"Finland, covered with its network of lakes and forests, suggests in its structure the days of the Creation, when water and earth were first separated. It is a country of vast dimensions and solitudes: although ten the times of Switzerland, it contains only the same number of inhabitants. Copper, timber, water - these are its principal resources. Finland is favored in that its ten thousand lakes are connected in four or five systems and have outlets to the sea, not to the frozen sea as in Russia, but to the west and to the south."*

Sigfried Giedion: *Space, Time & Architecture* (2008, 622)

*Men in Pyhäkoski rapids, 1933. This was the only way to cross the river before the suspension bridge was built in 1934. Photo: unknown © Fortum Power and Heat.*

## History

The water system of the River Oulujoki has always been an arterial road of a frontier. Throughout time, the water system has been utilised in various ways and by many parties. This system has connected the eastern and western cultures of Finland and has also made it possible to access the vast Finnish wilderness and its natural resources.[1]

The oldest role of the river was related to farming and animal husbandry. In the seventeenth and eighteenth century, it was a war route for the armies of Sweden and Russia. In the late nineteenth century, when Northern Finland was a major tar producer, the River Oulujoki also served as the most important tar route in the world. The rivers were famous for being teeming with fish, and salmon was an essential part of the local culture by providing sustenance and livelihood. The River Oulujoki and its rapids were also one of Finland's most popular tourist attractions in the early twentieth century. In addition, from the eighteenth century until the nineteen eighties, the rivers served the wood and pulp industry in Finland, as they were used to run logs.

During the reconstruction after the Second World War, the water system was harnessed to produce electricity with hydropower, which added a whole new layer to the cultural history of the area. During that process, some means of livelihood were lost. For example, the local fishing economy and tourism incurred substantial losses, but the change was more far-reaching than affecting only a single sector of the economy. Harnessing the rivers also erased the cultural and mental landscape of many generations. As the roaring rapids were silenced and ceased to exist, the locals witnessed first-hand how Finland took its first giant step toward industrialisation.

*1 Huhmo 2017, 22*

## Location

The water system of the River Oulujoki is located on Finnish territory in the northern hemisphere between the latitudes of 64°N and 65°N. In the west, it is bordered by the Bay of Bothnia (longitude 24°W) where the River Oulujoki flows. In the east, the water system reaches all the way to the Russian border (longitude 29°E). The power plants and residential areas are placed in a ribbon-like chain along the rivers. The harnessed rivers are the River Oulujoki, River Emäjoki, River Kiehimäjoki as well as the River Ontojoki.


*River Oulujoki water system (dark brown) seen on a map of Europe.*
*Map editing and stylization: Design Inspis Oy.*
*Original map material: National Land Survey of Finland, Topographic Database*

## Geography

The River Oulujoki has its origin in Lake Oulujärvi and its watershed area covers a significant part of the Oulu and Kainuu regions. The Oulujoki flows into the Bothnian Bay. The catchment area of the watercourse is the fifth largest in Finland and covers nearly 23,000 sq. km. Lakes account for 11.4% of the entire catchment area. Furthermore, nearly 90% of the waters of this area run through Lake Oulujärvi, which is the central reservoir.[2]

There are three main watercourses in the catchment area: Oulujoki, Hyrynsalmi and Sotkamo. While the River Oulujoki flows from Lake Oulujärvi to the Bothnia Bay, the Hyrynsalmi and Sotkamo watercourses are the two most important upper courses that flow near the Finland-Russia border into Lake Oulujärvi.[3] The main river on the Sotkamo route is the River Ontojoki, while in Hyrynsalmi route it is the River Emäjoki.

The length of the River Oulujoki is 107 kilometres and it has a head of 123 metres. This is significant considering the flat terrain in Finland. The mean flow is also affected by several smaller lakes and tributaries.[3] The origins of the River Emäjoki is Lake Kiantajärvi that has a head of 195.5–199.5 metres, depending on the regulation. The origins of the River Ontojoki is in Lake Ontojärvi near the Finnish-Russian border. Lake Ontojärvi has a head of 159 metres.

The watercourses of the River Oulujoki have been studied for decades. The first measurements were made in the late twentieth century.

*2 Oulujoki Power Company 1959, 3*
*3 Oulujoki Power Company 1959, 4*

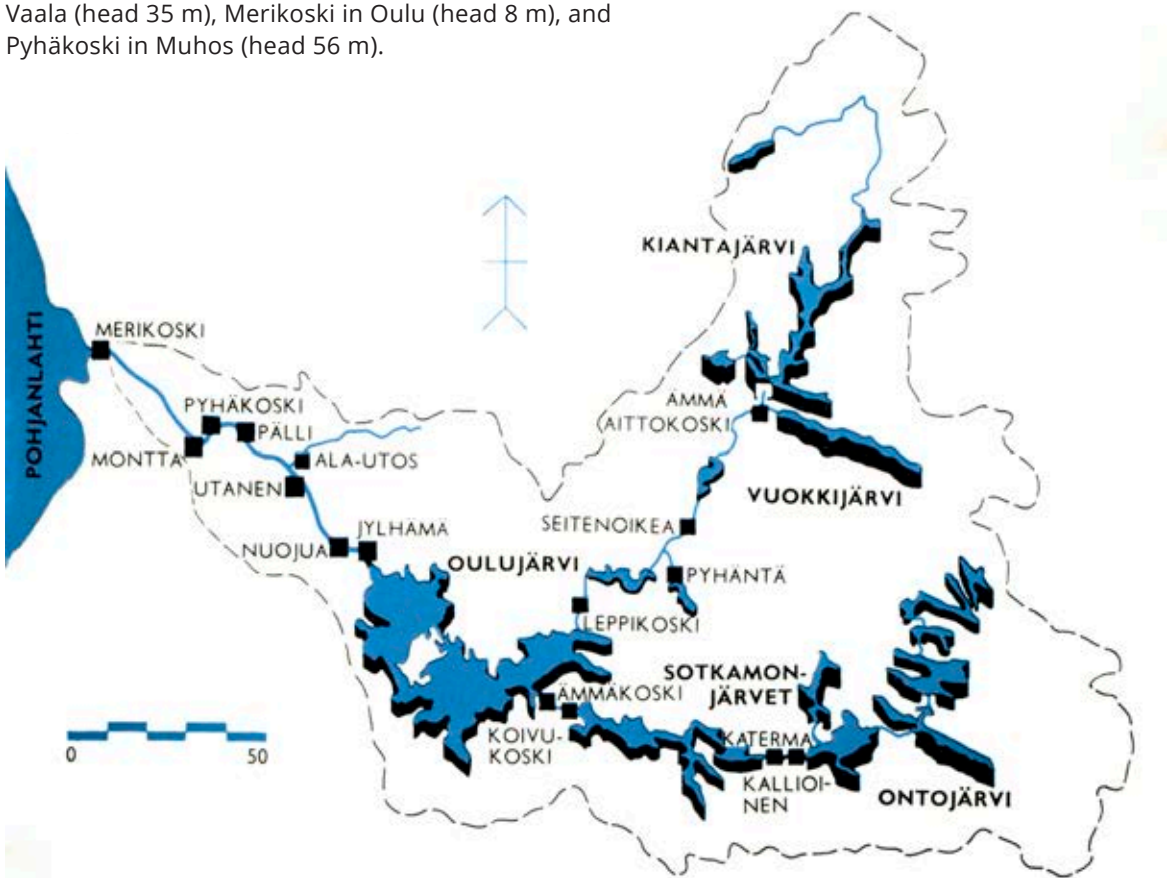
The water discharge at the starting point of the River Oulujoki, in Vaala, was measured between 1911 and 1950 and was as follows:

Maximum flood 7713/sec
Mean flow 2243/sec
Low water 573sec

The River Oulujoki had three large rapids that were renowned throughout the country: Niskakoski in Vaala (head 35 m), Merikoski in Oulu (head 8 m), and Pyhäkoski in Muhos (head 56 m).

Pyhäkoski was the largest stretch of rapids in Finland, consisting of three rapids. The smaller rapids were Ahmaskoski, Utakoski and Sotkakoski that lay between Niskakoski and Pyhäkoski. The rapids of Pälli were located between the municipalities of Utajärvi and Muhos.[1]

*1 Oulujoki Power Company 1959, 4*




*The power plants and regulating lakes in the catchment area of the River Oulujoki water system. Map: Oulujoki Power Company 1959, 43*


*The River Oulujoki in 1700s. Drawing: Anders Fredrik Skjöldebrand, Print: Charles Deléen & J. G. Forsgren. From the book: Voyage Pittoresque au Cap Nord, Stockholm 1801 (A. F. Skjöldebrand).*

# 1.4 Architects of The River Oulujoki Water System

*The executive branch inspecting the construction site at Montta. Aarne Ervi looking down at the camera. Photo: Foto Roos © Fortum Power and Heat.*

**Aarne Adrian Ervi** (orig. **Elers**; 19 May 1910, Forssa – 26.09.1977, Helsinki) was one of the most productive and significant Finnish architects of his time. His career extended from the 1930s to the 1970s. Ervi worked in all areas of construction and designed everything from furniture to power plants. Ervi's work catalogue includes over 500 designs and approximately 90 competition entries. His most important works include the Tapiola Garden City, the Porthania building of the University of Helsinki, the campus of the University of Turku and the hydropower plants of the River Oulujoki water system and their residential areas.[1]

Ervi earned his undergraduate degree in 1930 and graduated as an architect from the Helsinki University of Technology in 1935. Soon after graduating, he was offered work at Alvar Aalto's office where he participated in designing the Viipuri Library. After this he worked in the office of Toivo Paatela. After his career began to gain momentum, he opened his own office in 1938. Ervi was 31 years old when the recently founded Oulujoki Power Company chose his office to design the hydropower plants and residential areas along the northern rivers.

When Ervi first began the Oulujoki project, he was a well-known architect but had not achieved a breakthrough. The commission for the Oulujoki Power Company was Ervi's first major assignment.[2] Ervi and his office worked on the project for two decades, finishing the final power plant on the River Emäjoki in 1961. From 1965 to 1969, he worked as the director of the Helsinki town planning agency.[3]

Ervi was particularly interested in the technical aspects of architecture. He was one of the pioneers in standardisation and prefabricated construction in Finland.[4] Ervi also had a career as a teacher of architecture at the Central School of Applied Arts 1938–1939 and at the Helsinki University of Technology 1944-45.

His oeuvre is labelled by the pursuit of holistic design and an attempt to understand nature as a part of architecture. Ervi's architecture was not limited to façades or exterior walls as they were always part of their surroundings. In Ervi's best work, the buildings open up to the surrounding landscape through doors, windows, balconies and porches. Nature is led inside the buildings with abundant natural light and carefully placed views through the windows. The surrounding yards were usually treated with thoughtful garden plans.[5]

All this is particularly evident in the power plants and residential areas of the River Oulujoki Water System, where he could demonstrate the breadth of his competence from planning to small structural and interior details. During the Oulujoki project, Ervi could also fully orient himself to concrete construction, from the massive concrete casts of Pyhäkoski to the lighter precast panels of his later power plants.

*1 Arkkitehtuurin sanakirja 2000, 70*
*2 Makkonen 1994, 22*
*3 Finnish Museum of Architecture*
*https://www.mfa.fi/kokoelmat/arkkitehdit/aarne-ervi/*

*4 Arkkitehtuurin sanakirja 2000, 70*
*5 Johansson, Lahti & Paatero 2010, 8*

*Eino Pitkänen. Picture ©: Kainuu Museum/Archives of Simo Pitkänen*

**Eino Pitkänen** (9 January 1904, Kuopio –11 August 1955, Helsinki) is one of Northern Finland's most significant architects. The architecture office of Eino Pitkänen, located in Kajaani, is apparently the oldest architecture office in Northern Finland. It opened for business in 1940 and has an extensive work catalogue.

Eino Pitkänen was born on 9 January 1904 in Kuopio. Pitkänen studied at the Helsinki University of Technology from 1923 to1931. From an architectural standpoint, that period is interesting and challenging because functionalism was taking hold and new ideas were being introduced to design and construction that challenged the dominant Nordic Classicism. The most prominent of Pitakänen's early works is the Carlson commercial building in Kuopio. This building, finished in 1929, designed rather strictly in the style of Nordic Classicism, is an important element in the cityscape of Kuopio. Other important early works include classicist Riistavesi church (1934) designed together with architect Harry W. Schreck and the Iisalmi church designed in the same year.

Pitkänen moved to Kajaani in 1934. First, he worked teaching drawing and woodwork in the seminary. His first more challenging design jobs were the fully functionalist Kajaani police station (1934) and the printing hall of Kainuun Sanomat, the local newspaper, which was completed in 1936. In 1940, Villa Koskikara, a functionalist villa designed for the managing director of the Kajaani Timber Company, was finished on the bank of the River Kajaanijoki. It is impossible to assess Pitkänen's work without considering his vast projects for Kajaani Inc., which included factory buildings, interior design, furniture, apartment buildings and houses both for the workers and management.

Pitkänen's work catalogue also includes the hydropower plants and residential areas of Katerma (Kuhmo municipality), Kallioinen (Sotkamo municipality) and Koivukoski I-II and the refurbishment of Ämmäkoski in Kajaani. He also designed the residential area of Leppikoski power plant.

On the other hand, Pitkänen assumed the significant role as the moderniser of the cityscape of post-war Kajaani. The wooden town, ravaged by the war, was transformed into a city that has functionalist architecture of nationwide significance. Designing schools was an important part of Pitkänen's work during the post-war reconstruction. Besides Kainuu, Pitkänen designed the school buildings for Northern-Karelia, Northern Savo and central Finland. His last school building was the lyceum for girls in Kajaani, finished in 1955, while the earliest was Vehmersalmi elementary school at the end of the 1920s.

The third dimension in Pitkänen's career were the individual buildings designed all over the country but especially in Eastern and Northern Finland. In Oulu two buildings designed by Pitkänen, the Valkealinna –building and the former Cooperative Bank building (nowadays theatre Rio), hold a significance for the cityscape. In 1953, Pitkänen moved from Kajaani to Äänekoski where he designed buildings such as Äänekoski state office building (1954). Eino Pitkänen died August 11th 1955 in Helsinki.

*Alvar Aalto. Picture ©: Museum of Finnish Architecture*

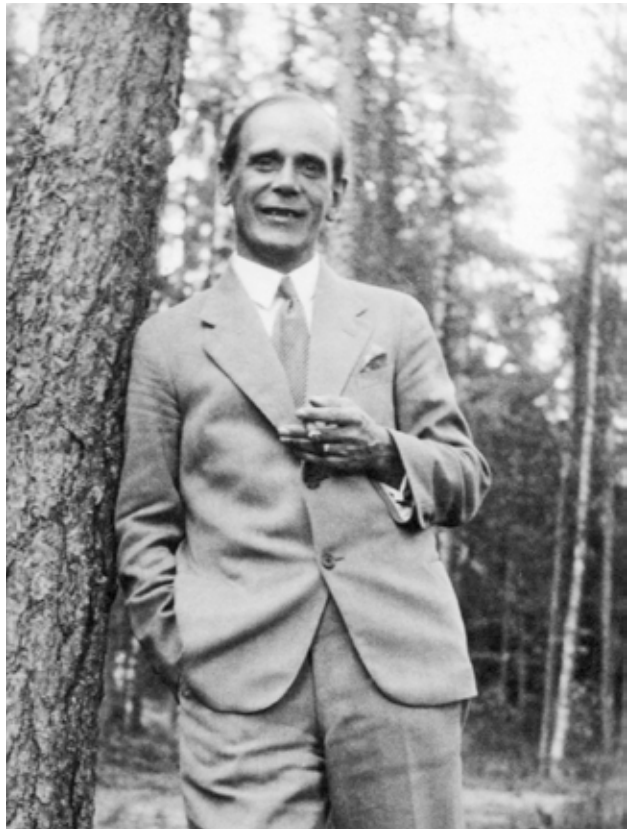
**Alvar Aalto** (3 February 1898, Kuortane – 11 May 1976, Helsinki). Hugo Alvar Henrik Aalto is internationally one of the most famous architects of the functionalist and post-functionalist eras. He began his career in the 1920s in the spirit of classism but at the end of that decade, he moved on to functionalism. The best examples of his early functionalism are the Paimio sanatorium and the Viipuri library. After the Second World War, Aalto worked abroad in the United States, the Federal Republic of Germany and France. Aalto's red brick buildings of the 1950s were also internationally revered. Most notable are the Town Hall of Säynätsalo and the House of Culture in Helsinki. Aalto was also an important designer of furniture, lights and glassware. He was a member of the Finnish Academy 1955–1968 and served as its director from 1963 until 1968. For the River Oulujoki, Aalto was responsible for the detailed plan of the Koskikeskus district in Oulu, which he designed in the 1940s. The Koskikeskus district is located at the mouth of the River Oulujoki and also has the Merikoski hydro power plant designed by Bertel Strömmer that was introduced in 1948.[1]

**Bertel Strömmer** (11 July1890, Ikaalinen – 18 April 1962, Tampere). Bertel Evert Strömmer studied architecture at the Helsinki University of Technology and graduated as an architect in 1913. During his studies, he worked in several architecture offices. After graduation, he worked in Eliel Saarinen's office between 1913–1914. In 1918, he accepted the position of the City Architect of Tampere. He held that position for 35 years and consequently, he had a significant impact on the cityscape of Tampere.[2]

Strömmer worked in several different styles throughout his career. He began as a classicist but during the 1930s, he started to favour a more reduced functionalist style.

Despite this, Strömmer did not approve of the societal aspects of functionalism and approached it more as an aesthetic. He made several trips abroad and visited Sweden, Norway, Denmark, Germany and Italy.[3]

*1 Arkkitehtuurin sanakirja 2000, 100*
*2 Museum of Finnish Architecture*
*https://www.mfa.fi/kokoelmat/arkkitehdit/bertel-strommer/*
*3 Museum of Finnish Architecture*
*https://www.mfa.fi/kokoelmat/arkkitehdit/bertel-strommer/*



*Bertel Strömmer. Picture: Vapriikki Archives © CC BY 2.0*

In 1942, the City of Oulu organised a architecture competition for the Koskikeskus district. Strömmer and Alvar Aalto submitted their proposals. Aalto won, but Strömmer was given the task of designing the powerhouse for the hydropower plant that was in the process of being built on the rapids of Merikoski. The plant was completed in 1948.[4]

*4 Museum of Finnish Architecture*
*https://www.mfa.fi/kokoelmat/arkkitehdit/bertel-strommer/*

# 1.5 Power Companies in the Waterway

## Oulujoki Power Company

In the 1930s, the interest of the Finnish state in hydropower turned from Southern Finland towards the northern rivers. Harnessing the rapids of the River Oulujoki was an issue that had been discussed extensively for decades. A grand plan for harnessing the waters of that river was completed in 1939.

When Finland lost a third of its electricity production capacity during the Second World War, it became a pressing matter to implement the plan. There was also a strong demand for electricity by Finland's industry. Owing to the magnitude of the venture, it was decided that a state majority-owned company was going to be founded to run the project.

The Oulujoki Power Company (Oulujoki Osakeyhtiö) was founded on 1 April 1941. In September of the same year, the company already owned a majority of the rapids on the River Oulujoki, not including Merikoski, which was owned by the City of Oulu. The biggest stock owner was a state-owned power company, Imatran Voima (65.5%). Other owners included Tampereen Pellava- ja Rautateollisuus (The Linen and Iron Industry of Tampere, 16.75%), A. Ahlström (10.65%) and Yhtyneet Paperi- tehtaat (Merged Paper Mills, 7%).

The Oulujoki Power Company built a total of ten power plants on the waterway. These include Pyhäkoski (1951), Jylhämä (1951), Pälli (1954), Nuojua (1955), Montta (1957), Utanen & Ala-Utos (1957) on the River Oulujoki that flows from Oulujärvi to the Bothnia Bay.The company subsequently moved north towards what is known as the Hyrynsalmi Route and the River Emäjoki that flows from Lake Kiantajärvi to Lake Oulujärvi. In Emäjoki, the company built Ämmä (1959), Aittokoski (1960), Seitenoikea (1961) and Leppikoski (1963). Leppikoski first began as a project by Kajaani Oy (Kajaani Power Company) and was later bought by the Oulujoki Power Company in 1962.

The first company CEO, from 1941 to 1948, was Hugo Malmi (1878–1956) with Väinö Tanner acting as chairman of the board. Later, the assignment was given to Niilo Saarivirta, M. Sc. (1898–1982), who served from 1948 to 1968. Saarivirta was probably the most influential company director and was active during the period that the River Oulujoki waterway was harnessed. Prior to his job as a CEO, he worked as a designer and a construction manager on the sites of this power plant. As a consequence, Saarivirta possessed an extensive knowledge of hydropower construction and management, and he became one of the leading authorities in Finland.

Besides the actual power plants, the Oulujoki Power Company also built several residential areas near the power plants. These were somewhat self-sufficient little villages that had their own schools, post offices, fire stations and in some cases, even movie theatres. The largest communities were Pyhäkoski in the municipality of Muhos as well as Jylhämä in Vaala. The commission to design these power plants and housing areas was granted to the architect Aarne Ervin and his office.

## From Oulujoki Power Company to Fortum

In 1991, the Oulujoki Power Company merged with Imatran Voima and in 1998, Imatran Voima merged with another state-owned energy company, Neste Oy, to form Fortum. Today the Finnish government owns 50.8% of Fortum. The company works in several fields of energy productions and owns or partially owns over 150 hydropower plants in Finland and in Sweden. All the power plants on the Oulujoki waterway remain operational and are currently owned by Fortum's affiliate company Fortum Power & Heat AB. The residential areas have been sold by the company and are now privately owned.

## Kajaani Ltd. (Originally Kajaani Timber Company)

Kajaani Ltd. was a company that operated out of the City of Kajaani in Eastern Finland. The company was founded in 1907 and produced paper, sawn timber and pulp. The company built a total of four hydropower plants in the Kainuu region: Ämmäkoski, Koivukoski I-II, Kallioinen and Katerma. Kajaani Inc. also began to build the Leppikoski plant but sold it to the Oulujoki Power Company before it was finished. Small residential areas were built near Kallioinen and Katerma. The architect who designed a majority of the power plants and housing areas was Eino Pitkänen. Pitkänen and Kajaani Oy maintained a long relationship and his clear functionalism is a characteristic of many of the company buildings.

## From Kajaani Ltd. to UPM

In 1989, Kajaani Ltd. merged with Yhtyneet paperitehtaat (United Paper Mills). Yhtyneet paperi-tehtaan in turn merged with several other companies to form UPM in 1996. UPM is currently the eighth-largest company in Finland.

# 1.6 The Case for UNESCO World Heritage Site

Unesco approved the Convention concerning the Protection of the World Cultural and Natural Heritage in 1972. The World Heritage Convention is a global decision to promote the treasuring and preservation of unique cultural and natural heritage for future generations. Currently there are seven World Heritage sites in Finland.[1]

## Veli-Pekka Huhmo's preliminary study

In 2015, several municipalities along the River Oulujoki water system wanted to examine the World Heritage values of the waterway. The following year, a preparatory seminar was held in Oulu in which the matter of preliminary study was discussed. Back then, it was known that Finland intended to update its list of proposals for the UNESCO World Heritage status. Currently, Finland has seven World Heritage sites. These are the following: the Fortress of Suomenlinna, Kvarken Archipelago, Old Rauma, Petäjävesi Old Church, the Verla Groundwood and Board Mill, the archaeological site of Sammallahdenmäki and the Struve Geodetic Arc.

The preliminary study was commissioned soon after this and the job was given to the architect Veli-Pekka Huhmo. He completed this work in 2017. His report, titled "Oulujoen vesistön voimalaitosarkkitehtuuri – Esiselvitys maailmanperintöarvoista" (Hydropower architecture of the River Oulujoki water system – a preliminary study), establishes the basis for considering the world heritage values of the waterway. Huhmo's work focussed on the modernistic hydropower architecture in the area.

The World Heritage List currently (March 2021) includes 1,121 sites. To be accepted for the World Heritage List, sites must be of outstanding universal value and meet at least one out of ten selection criteria. Criterion viii is an exception because it needs to be connected to another criterion.[2] The ten criteria are as follows:

**(i)** To represent a masterpiece of human creative genius;

**(ii)** To exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design;

**(iii)** To bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;

**(iv)** To be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history;

**(v)** To be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;

**(vi)** To be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance.
(The Committee considers that this criterion should preferably be used in conjunction with other criteria);

**(vii)** To contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

**(viii)** To be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of landforms, or significant geomorphic or physiographic features;

**(ix)** To be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

**(x)** To contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

1 (Finnish Heritage Agency, https://www.museovirasto.fi/en/about-us/international-activities/world-heritage-in-finland)

2 UNESCO, https://whc.unesco.org/en/criteria/

In his study, Huhmo (2017) concludes that the strongest World Heritage criteria for the River Oulujoki water system are number two (ii) that represent the interchange of human values, and number four (iv) that appreciates architectural and technical achievements.

The Finnish Heritage Agency released a report on 25 March 2019 that listed the potential sites in Finland that would possibly be eligible for the UNESCO World Heritage List. The hydropower architecture of the River Oulujoki water system is one of the candidates on that list. The report categorises sites according to their potential. The hydropower architecture of the River Oulujoki water system is placed in the category of "Requires further research". Furthermore, the report states:

*"The hydropower architecture of the River Oulujoki water system is an excellent and nationally very significant industrial system. Due to its scale, it is rather exceptional in Finland. However, at present, the potential of the site to signify universal value is not absolutely clear. Similar power plants can be found in the US, Canada, Russia, China and Brazil. The World Heritage List already has a similar type of site in Norway: Rjukan Notodden. One of the arguments for this site was its hydropower."*

The task force states that the hydropower architecture of the River Oulujoki has potential but the research must be expanded to the engineering sciences. The standardisation and construction technique also demand further study in order to signify special value.Technically, the Finnish power plants are similar to what other countries had already begun to use. To present this site as an example of environmental change would require a completely different approach by providing further support to show the site before and after the change. The task force concludes that by citing merely hydropower or architecture as justifications, it will be difficult to include the hydropower architecture of the River Oulujoki water system on the World Heritage List.

In part, the VekuVaku project and this atlas provide further and more specific information on the hydropower architecture in the water system and in doing so, attempts to meet the demand for "further research" by the Finnish Heritage Agency. It also focusses on the integrity and authenticity of the architecture, these being important factors in considering the UNESCO World Heritage status.

Since the beginning of the VekuVaku project, Finland has moved forward with its proposal. For example, in February of 2021, Finland decided to propose that the "The Humane Architecture of Alvar Aalto" be accepted for the UNESCO World Heritage List. The Humane Architecture of Alvar Aalto includes 13 different Alvar Aalto sites and buildings throughout Finland. This means that the hydropower architecture of the River Oulujoki water system will be eligible when Finland next decides to propose sites for the World Heritage List.

# 2. Hydropower of the River Oulujoki Water System – a Short History

The rivers running through the Oulu and Kainuu regions were utilised, dredged and transformed hundreds of years before the building of the actual hydropower plants. The oldest historical document found in Finland that relates to hydropower dates back to 1352 when a water mill was built on the rapids of Halistenkoski in Western Finland.[1] During the next century, over a hundred water mills were constructed throughout Finland[2]. Historically, locals in that region harnessed the hydropower of the River Oulujoki as well as in Kainuu[3]. Different types of sawmills and watermills had been built all across the area. The Kainuu region was particularly renowned for its watermills that were situated along its rapids and streams.

*Peurokoski bull mill in Kainuu, photo: Karoliina Kikuchi © Museum of Kainuu*

*1 Salokangas (toim) 1968, 14*
*2 Holml 1991, 19*
*3 Oulujoki Power Company 1959, 5*

This pre-modern period of hydropower pertained to the local small economies, farming as well as the self-sufficiency of small communities.

It is also important to note that as soon as water mills became more common, questions concerning the ownership and usage of hydropower became relevant because several mill builders were usually interested in the same rapids[4].

In the eighteenth and nineteenth century, the rivers were dredged and modified to enable the tar boats to have better passage through the rapids as pine tar was the central export product of the region during the 1800s. Tar was produced in the remote backwoods and then transported to Oulu by river from where it was subsequently shipped abroad. However, the tar trade began to wane in the early 1900s and finally came to an end in 1910. During the nineteenth and twentieth centuries, the paper and pulp industry became dominant and the rivers were used for log driving. Log running continued until the 1980s and as a consequence, troughs and lifts had to be constructed to enable the logs to pass the power plants and dams.

## Hydropowered electricity production begins

The first public hydropower plant that produced electricity in the water system was built in 1903 on the Lasaretti channel in Oulu. This facility functioned as the city's own power plant. This was the first time that the River Oulujoki produced electricity for the general public. These first municipal power plants were primarily used to power street lights.[5]

*4 Holm 1991, 19*

The industry began to increasingly use electricity as a power source in the 1910s. To address this, a state committee was established to study the use of hydropower in the early twentieth century. Finland's capacity to produce electricity increased significantly during the next decade. At the beginning of the 1920s, Finland produced approximately 200 MW of electricity and approximately half of that was produced by hydraulic power. In 1922, the Finnish Senate decided that a large hydropower plant would be constructed at the famous Imatra Rapids. This was a major change in the energy strategy of Finland, a country that had just recently gained its independence.[6]

The Imatra hydropower plant, designed by Hugo Malmi, was finally finished in 1929. With its capacity of 192 MW, it continues to be the largest hydopower plant in Finland. In 1937, the Rouhiala hydropower plant, the second largest in the country, was completed in Vuoksi, Eastern Finland. This plant had a capacity of 109 MW. Vuoksi also had three smaller power plants that were built earlier: Tainionkoski, Pankakoski and Juankoski. The River Kymijoki water

*5 Enbuske 2010, 311*
*6 Enbuske 2010, 311*

system had five power plants constructed in the early 1900s and the River Kokemäenjoki water system had three. This meant that the three main water systems in Southern Finland were harnessed by the 1940s.[7]

## Attention turns north

Interest in the northern rivers arose in the early twentieth century. Between the two world wars, Finland's industrial production increased at an annual rate of eight per cent. Industries that were particularly important were those of paper and pulp. At the same time, private electricity consumption was growing.

For this reason, a stable and domestic power source was essential. The City of Oulu began planning its own municipal hydropower project already in 1914, but the Water Rights Act of 1902, which stipulated that the main channels had to remain open, still prohibited the construction.[8]

The government's Rapids Power Committee was founded in 1917. One of its objectives was the hydropower of the River Oulujoki. The year1934 marked a significant change in the environmental management system when the Water Rights Act was clarified. The new law made it possible to close the channel completely and therefore build hydroelectric plants in these large northern salmon rivers, such as the River Oulujoki.[9]

Finland took part in the Second World War and fought against the Soviet Union from 1939 to1940 and from 1941 until1944. As a result of this, Finland lost approximately a third of its hydropower, including Rouhiala[10]. This meant, that the hydropower potential of Finland's northern rivers became even more vital.

*7 Holm 1991, 30*
*8 Enbuske 2010, 310*
*9 Enbuske 2010, 311*
*10 Holm 1991, 30*

In November of 1940, a bill was brought before Finnish parliament that concerned the state-owned hydropower along the River Oulujoki. The bill stated that the river sections suitable for hydropower would be handed over to a state-owned power company, Imatra Voima. A comprehensive plan for harnessing the river was completed in the previous year.

The reasoning was that the River Oulujoki could produce approximately 1900 GWh of energy a year. It was also stated that by harnessing the river, the water system could be regulated. Also the country's industry would greatly benefit from the venture because the electricity could be transferred to Southern Finland. The local companies would also have easy access to electricity.[11]

On 31 January 1941, Imatran Voima purchased the state-owned river sections and the land areas connected to them for 12 million Marks. In April of the same year, the Oulujoki Power Company was founded, with Imatran Voima as the majority shareholder. Other shareholders included Tampella, Ahlström corporation and United Paper Mills.[12]

The first power plant on the river, Merikoski, was built by the City of Oulu and it was finished in 1948. Other power plants on the main channel of the River Oulujoki were built by the Oulujoki Power Company between 1949–1957. These included Montta, Pyhäkoski, Pälli, Utanen, Nuojua and Jylhämä. The power plants were designed by the architect Aarne Ervi and his office. This part of the venture also included the regulation of Lake Oulujärvi.[13] The nearest international reference point is probably an American federally owned corporation, the Tennessee Valley Authority, which was an agency established during New Deal era that built a series of hydropower plants in the Tennessee Valley in the 1930s. Ervi famously visited Tennessee valley after the war in 1947 and was impressed by the massive dam structures of Roland Wank and Albert Kahn[14].

*11 Holm 1991, 30*
*12 Vuorinen 2015, 35*
*13 Holm 1991, 30*

After River Oulujoki, the company started building river Emäjoki, north from Lake Oulujärvi. This so-called Hyrynsalmi route includes, Ämmä, Aittokoski and Seitenoikea hydro power plants.[15] In Kainuu region, in River Ontojoki, Kajaani Ltd. built two power plants, Katerma (1950) and Kallioinen (1957). These power plants were designed by the architect Eino Pitkänen. In 1963 the Leppikoski power plant in river Kiehimäjoki, designed by Reino Laaksonen, was also built by Kajaani Ltd. Leppikoski was later aquired by Oulujoki Power Company.

The post-war hydropower boom began slowing down during the 1960s as other forms of energy production were gaining more momentum. Harnessing the main channel of River Kemijoki in northern Finland, can be seen as an end point in the hydropower construction of Finland.[16]

Statistics indicate that between 1930 and 1970, hydropower accounted for two-thirds of the total electricity produced in Finland. As early as in 1966, hydropower was sufficient to power almost all of Finnish industry, with wood processing industry using 46% of the electricity and other industry consuming 22%. By the 1980s, the share of hydropower of the total energy production had fallen to 25%. This was primarily due to nuclear power. However, even in the 1980s, new hydropower was being constructed. The power plants built during that decade produced up to 140 MW.[17]

*14 Huhmo 2015, 44*
*15 Holm 1991, 30*
*16 Holm 1991, 32*
*17 Holm 1991, 32-33*

# 3. Hydropower Plants in the Water System

| | Power Plant | Builder | Current owner | Power | Year |
|---|---|---|---|---|---|
| **Oulujoki route** | | | | | |
| River Oulujoki | | | | | |
| | Merikoski | City of Oulu | City of Oulu | 40MW | 1948 |
| | Pyhäkoski | Oulujoki Power Company | Fortum Power and Heat | 147MW | 1951 |
| | Jylhämä | Oulujoki Power Company | Fortum Power and Heat | 55MW | 1951 |
| | Pälli | Oulujoki Power Company | Fortum Power and Heat | 51MW | 1954 |
| | Nuojua | Oulujoki Power Company | Fortum Power and Heat | 85MW | 1955 |
| | Montta | Oulujoki Power Company | Fortum Power and Heat | 47MW | 1957 |
| | Utanen & Ala-Utos | Oulujoki Power Company | Fortum Power and Heat | 58.5MW | 1957 |
| | Pikkarala electricity conversion station | Oulujoki Power Company | Fortum Power and Heat | | |
| **Hyrynsalmi route** | | | | | |
| River Emäjoki | | | | | |
| | Pyhännänkoski | Kainuu Municipalities Elec. Ltd. | Ekosähkö Ltd. | 3MW | 1957 |
| | Ämmä | Oulujoki Power Company | Fortum Power and Heat | 16MW | 1959 |
| | Aittokoski | Oulujoki Power Company | Fortum Power and Heat | 45MW | 1960 |
| | Seitenoikea | Oulujoki Power Company | Fortum Power and Heat | 38MW | 1961 |
| River Kiehimänjoki | | | | | |
| | Leppikoski | Kajaani Ltd. | Fortum Power and Heat | 23MW | 1963 |
| **Sotkamo route** | | | | | |
| River Kajaanijoki | | | | | |
| | Ämmäkoski | Kajaani Ltd. | Kainuu Power Company | 4,9MW | 1917/1940 |
| | Koivukoski I-II | Kajaani Timber Company | Kainuu Power Company | 6.5MW | 1943 |
| | Koivukoski III | Kainuu Power Company | Kainuu Power Company | 20MW | 1995 |
| River Ontojoki | | | | | |
| | Katerma | Kajaani Ltd. | UPM Energy | 10MW | 1950 |
| | Kallioinen | Kajaani Ltd. | UPM Energy | 13.9MW | 1957 |


*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

# 4. Housing Typology

Aarne Ervi and his office had selected standardisation as their method and guideline. As a result, certain house-types and models were used throughout the whole venture and these can be seen in many of the residential areas and in a majority of the buildings.

Through archival research, we have discovered that the types of houses used during this project were detached and semi-detached house types B3, B4 and A3 (Leppiniemi), A50, A90 (Jylhämä), A1 and B1 (Ämmä and Aittokoski) and B5 and B6 (Seitenoikea).

This aspect is also important, because Ervi was one of the pioneers of standardisation in Finland. Between 1942 and 1945, he worked as a director of the Finnish Institute of Standardisation. The Oulujoki project was therefore a significant proving ground where his new ideas and solutions could be tested and developed.[1]

Ervi's housing typology has a hierarchical structure, which is similar to the pre-industrial forge-communities in Finland. The overall features of the building are dictated by the structural and dimensional standards created for the project. Houses were built with high-quality standards and could benefit from the latest developments and techniques of the period.[2]

For example, many apartment (including the workers apartments) had a shower and a toilet, which were unusual features in 1940s Finland. In part, this was possible because considering the times, the project had exceptional resources [3].

The houses and residential areas were usually planned according to a certain social hierarchy. This meant that the largest and most luxurious detached and semi-detached houses were reserved for the executive branch. The more modest, single- or two-family houses, row houses and apartments were built for the average workers. For the purpose of this atlas, we have divided the buildings in the housing and service areas into the following nine categories:

1. Temporary buildings

2. Detached and semi-detached houses

3. Row houses and linked houses

4. Apartment buildings

5. Offices and other commercial buildings

6. Industrial buildings and warehouses

7. Garages

8. Public buildings and guesthouses

9. Service buildings and saunas

## 1. Temporary buildings

Thousands of builders worked and lived on the construction sites located along the rivers from 1939 to1963. They were housed in temporary barracks, tents and some even lived in cardboard huts. In addition to housing, other structures that were needed, including warehouses, canteens, schools, day care centres, fire stations as well as places to exercise and engage in leisure activities.

The greatest concentration of temporary buildings was on the River Oulujoki, more specifically in Leppiniemi and Jylhämä, which were the main construction hubs.

When busiest, Jylhämä housed over 2,000 residents. In some cases, these temporary buildings were not actually temporary. For example, the last barracks in Leppiniemi were demolished in 1959, nearly a decade after the Pyhäkoski power plant was finished and operational. Residents subsequently moved into the new apartment buildings.

*1 Huhmo 2017, 66*
*2 Ibid*

*3 Huhmo 2017, 67*

## 2. Detached and semi-detached houses

According to the hierarchical system in the company, the detached and semi-detached houses built in all residential areas were originally reserved for the executive branch and head engineers. These houses were constructed out of stone or wood and had lush gardens. The exterior and interior spaces were also connected by terraces and large windows. These houses featured concrete foundations and roofs constructed of either sheet metal, felt or tile. They were also built next to the river and occasionally had private saunas by the water. Later, Ervi designed smaller, more modest, detached houses which were built on less valuable plots.[1]

The semi-detached houses were built for particularly important employers. The floor plans were open, but Ervi sought to create a sense privacy with the overall disposition. These stone-built houses were constructed according to the same high-quality standards as the detached houses.[2]

## 3. Row houses and linked houses

Row houses were constructed in several housing areas across the rivers. These include Montta, Leppiniemi, Utanen, Nuojua, Jylhämä and Seitenoikea. These usually had one floor (+basement), concrete foundation, a tile roof and frames constructed out of lightweight concrete blocks called Betocell. The facades were made of bricks that have been rendered white. The windows and doors were constructed out of wood. These row houses were predominantly built for the workers and for their families.

## 4. Apartment buildings

The construction of the Leppiniemi residential area also encountered some problems, as the houses built during the 1940s and 1950s, were not sufficient for the people who remained in the area after the power plant was completed. The power plant was finished in 1951, but at the end of the decade, people continued to live in temporary barracks in relatively poor conditions.

The situation was resolved by building six three-story apartment buildings at the southern edge of the area, and people moved there at the end of the 1950s and beginning of the 1960s. This greatly improved the living conditions of these people. These apartment buildings exist today as an integral part of the area. The buildings were designed by Aarne Ervi and his office.

## 5. Offices and other commercial buildings

The corporate and administrative infrastructure of the Oulujoki Power Company was maintained by a series of offices and bureaus. It is worth noting that the power plants also had offices and particularly Pyhäkoski served an administrative hub. For example, Pyhäkoski powerhouse was the place where workers would collect their salary. In the 1980s, the regional office of the Oulujoki Power Company was built in Leppiniemi and afterwards, it became the centre for the company's administrative and managerial tasks.

Other important commercial buildings built in the residential areas were the general stores and grocery stores in Leppiniemi and Jylhämä. These buildings would also host several other commercial activities such as barbershops, butcher shops and bookstores. Jylhämä also famously had a small movie theatre.

## 6. Industrial buildings, warehouses

Many industrial buildings were built in the proximity of the power plants as a part of the power plants service infrastructure. Most of these buildings were warehouses of different sizes but different types of workshops, service halls and garages were also built. The highest concentrations of these are currently found in Pyhäkoski and Jylhämä.

*1 Huhmo 2017, 66*
*2 Huhmo 2017, 66*

## 7. Garages

During the 1950s, private cars were rare in Finland. In these power plant communities in the 1940s and 1950s, people travelled by company cars and busses. It was also common that the area's service building had a garage for the company car.

During the 1960s, after import restrictions were lifted, privately owned cars began to become more and more available in these rural areas of the country. As a result, the garages built in these residential areas are commonly from this period. In Nuojua, the old yard storages were later transformed into garages.

## 8. Public buildings, guesthouses

The construction of guesthouses reflects the expectancy that the Oulujoki project would receive wide-ranging attention. The company wanted executive lounges to entertain important guests. The guesthouses at Leppiniemi and Jylhämä were also well known and throughout history, several important persons spent the night in these houses, including several presidents. The public buildings also included schools and communal buildings such as club houses.

## 9. Service buildings and saunas

It was also rather common for residential areas to have service buildings that served different functions for the residents. These multipurpose buildings usually had a sauna, a laundry room, a garage for the company car, and an apartment for the caretaker. In many cases, they also had the old boiler room, which was originally operated with wood and later with oil. These service buildings would occasionally have bakeries, workshops and other recreational spaces These service buildings were naturally an integral part of life and personal maintenance in these communities.

Saunas constituted an important part of everyday life in these power-plant communities. Although these houses were built in the 1940s and 1950s, they usually did have showers, communal saunas were still essential for everyday hygiene and were, and remain today, an important part of Finnish culture. Detached log-constructed saunas built on the waterfront were also rather common. Occasionally these were segregated by profession, in that the workers and the executive branch would have their own saunas.

# 5. Sites

On 31 January 1941, Imatran Voima bought the state-owned river sections and the land areas connected to them on the River Oulujoki, for Mk12 million. In April of the same year, the Oulujoki Power Company was founded, with Imatran Voima as the majority share- holder. The mission of the newly founded power company was to build and maintain a chain of hydropower plants along the River Oulujoki water system. The main construction period was between 1939 and 1963.

It is very important to understand this project for what it was. These were not individual facilities unrelated to each other. Instead, this was a chain of power plants designed to work together as a synchronised mega system with Lake Oulujärvi serving as the main reservoir. This chain of power plants made it possible to control and regulate the flow of the whole water system. This was also the best way to utilise and optimise the use of the river in a terrain that was relatively flat. During high water, water was impounded in the lakes and released during low water. The harnessed sections of the rivers have a total length of approximately 325 kilometres.

The water system is divided into three routes, the Oulujoki route (1) and the Hyrynsalmi route (2) that were built by Oulujoki power company, and the Sotkamo Route (3) built by Kajaani Ltd and UPM. For this reason, chapter five is divided into three sections with the power plants and residential areas presented in chronological order. Chapter 5.1 introduces the Oulujoki route. Chapter 5.2 provides information on the Sotkamo route and chapter 5.3, the Hyrynsalmi route. Merikoski was the first power plant to be completed in 1948 and was built by the City of Oulu. After this, the Oulujoki Power Company harnessed the River Oulujoki as well as the River Emäjoki and the power plants were finished in the following order: Pyhäkoski (1951), Jylhämä (1951), Pälli (1953), Nuojua (1955), Montta (1957), Utanen (1957), Ämmä (1959), Aittokoski (1960) and Seitenoikea (1961). Meanwhile in Kainuu, Kajaani Ltd. had been building river Ontojoki near the eastern border. Ämmäkoski had already been built in 1917 and Koivukoski I-II was finished in1943. This was followed by Katerma (1950), Kallioinen (1957) and finally Koivukoski III (1995).


*Drainage basin of the River Oulujoki water system, with all of the power plants. Bothnia Bay is on the left and the Russian border on the right. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

# 5.1 Oulujoki Route

At the beginning of the project, the Oulujoki Power Company divided the river into two sections and as a consequence, two task forces were created. These were based in Pyhäkoski and Jylhämä. Each had a mission to build three power plants and residential areas. The lower reaches (Montta, Pyhäkoski and Pälli) were to be constructed using Pyhäkoski as a base, whereas the upper reaches (Utanen, Nuojua and Jylhämä) were to be built from the Jylhämä construction hub. When busiest, these two communities had almost 4,000 workers[1].

The key figures in harnessing the River Oulujoki were Niilo Saarivirta and Aarne Ervi. Saarivirta was the lead hydropower designer for the project between 1941 and 1945 and he served as the construction manager from 1945 to 1948. He subsequently worked as the CEO of the Oulujoki Power Company. Aarne Ervi and his office designed the architecture of the power plants. Other important hydropower designers were Osmo Korvenkontio, Veli Lehtonen, Juhani Kilpeläinen, Harri Sistonen and Ilkka Paaja.

The river was completely harnessed by seven power plants. These were built between 1939 and 1957. The company then built the Pikkarala electricity conversion station, which was a key component in transferring electricity to Southern Finland. The length of the harnessed river is approximately 91 kilometres and has a head of 123 metres.

This chapter includes:



*1 Kuuskoski 1991, 21, 101–102*

# 5.1.1 Merikoski and Koskikeskus

## Koskikeskus

While the Oulujoki Power Company built a majority of the power plants along the rivers, the first facility was constructed as an independent project by the City of Oulu on the rapids of Merikoski. Before this power plant was built, the rapids located at the mouth of the River Oulujoki were used for fishing salmon. This river was also an important route for boats that transported tar from the remote backwoods to Tervahovi at Toppila harbour. In fact, during the 1800s, Oulu's Tervahovi was one of the epicentres of the world tar trade.

The Merikoski power plant has a long history. As early as in 1914, when Bertel Jung drafted a detailed plan for Tuira, he mapped out an area for the power plant and for the channels[1]. However, the first actual plan for the power plant was drawn in 1919. The plant could not actually be built at that time due to the Water Rights Act of 1902, which was introduced to protect those who fished for a living. Even so, a city that was developing and industrialising needed electricity. When the price of coal skyrocketed in the 1930s, the need for the city to have its own power plant became increasingly obvious[2]. In 1939, the water Rights Act was changed. This made it possible to close the channel completely and to build hydroelectric power plants on the River Oulujoki.[3]

The City of Oulu began construction with the earthmoving works in the autumn of 1939. The construction of the dams and the canals also started. However, this work was halted due to the Winter War of 1939–1940, but following the peace treaty in 1940, the project resumed construction.

*Merikoski in 1908. The wooden dam, which was used for catching salmon, is a fine example of how the rivers were utilised before the power plants were built. Photo: U. T. Sirelius © Finnish Heritage Agency.*

In the early 1940s, the building board came to realise that the area would undergo a complete transformation. The previously green and lush shores were now to be covered with rocks and gravel from the excavations. At the last minute,[4] the board understood that they needed someone to design a plan for the whole area.

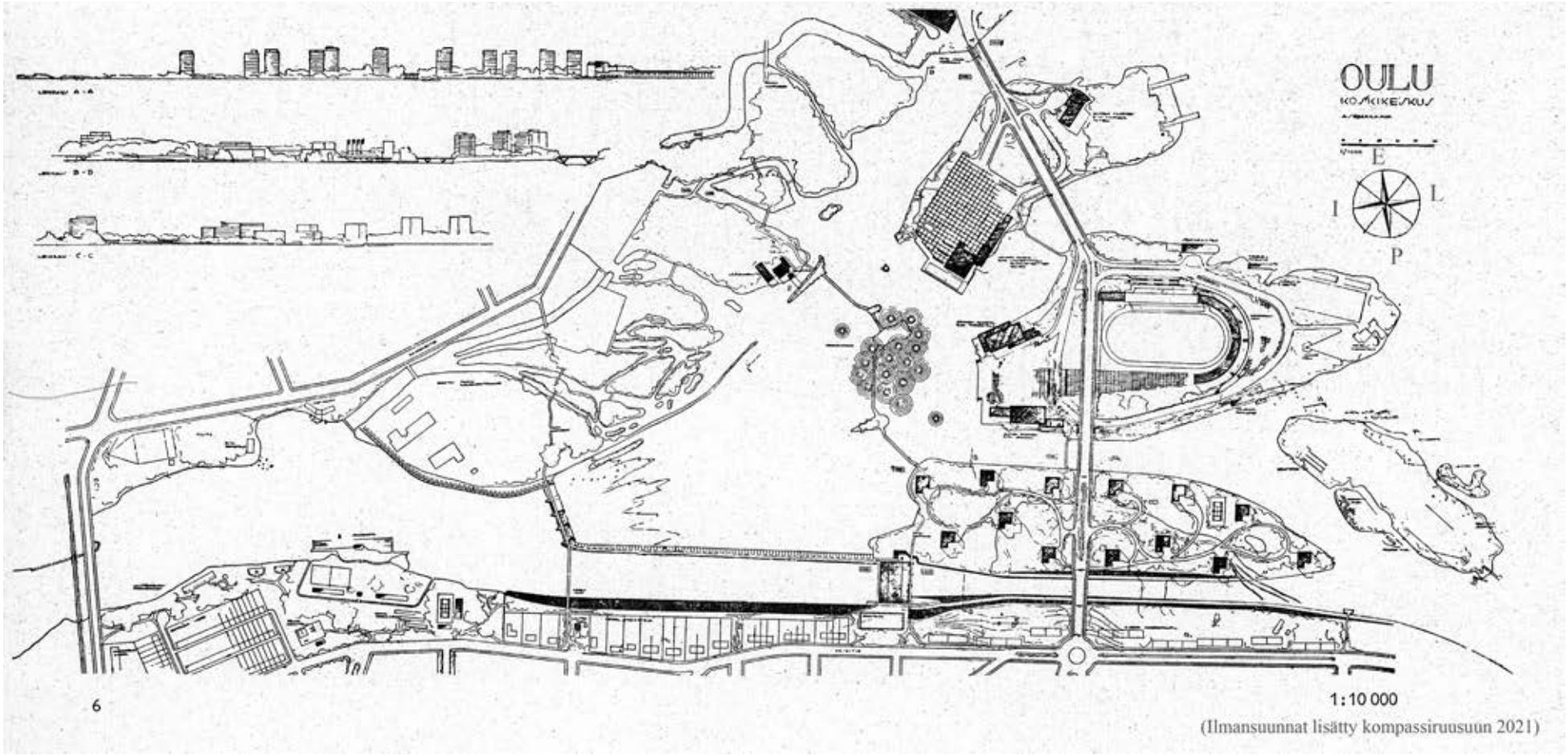
A member of the board and the deputy mayor of Oulu, Alpo Autio described the decision:

*"It was considered important, that the loss of natural values, which have long been dear to Oulu residents, would be compensated for by similar positive measures[5]."*

*1 http://www.rky.fi/read/asp/r_kohde_det.aspx?KOHDE_ID=2081*
*2 Vahtola, 2000, 44*
*3 Enbuske 2010, 313*

*4 Autio 1943, 1*

*5 Autio's introduction to Koskikeskus plan in Finnish Architectural Review 1-2 1943, 1*




*Aalto, detailed plan for Koskikeskus district. Finnish Architectural Review 1–2, 1943, 5.*

The building board also thought that the plan would also solve several open questions, such as the placement of bridges across the river and the new administrative buildings that the city sorely needed.[6]

In 1942, the board organised a competition where architects were requested to draw a plan of the whole district as well as to design the general architectural features of the Merikoski power plant. Three architects were invited to take part and Alvar Aalto and Bertel Strömmer submitted their proposals.

The competition was settled on 10 December 1942 and Aalto was declared the winner with his "Koskikeskus" plan.[7]

*6 Autio's introduction to Koskikeskus plan in Finnish Architectural Review 1–2 1943, 1*

*7 Autio 1943, 1*

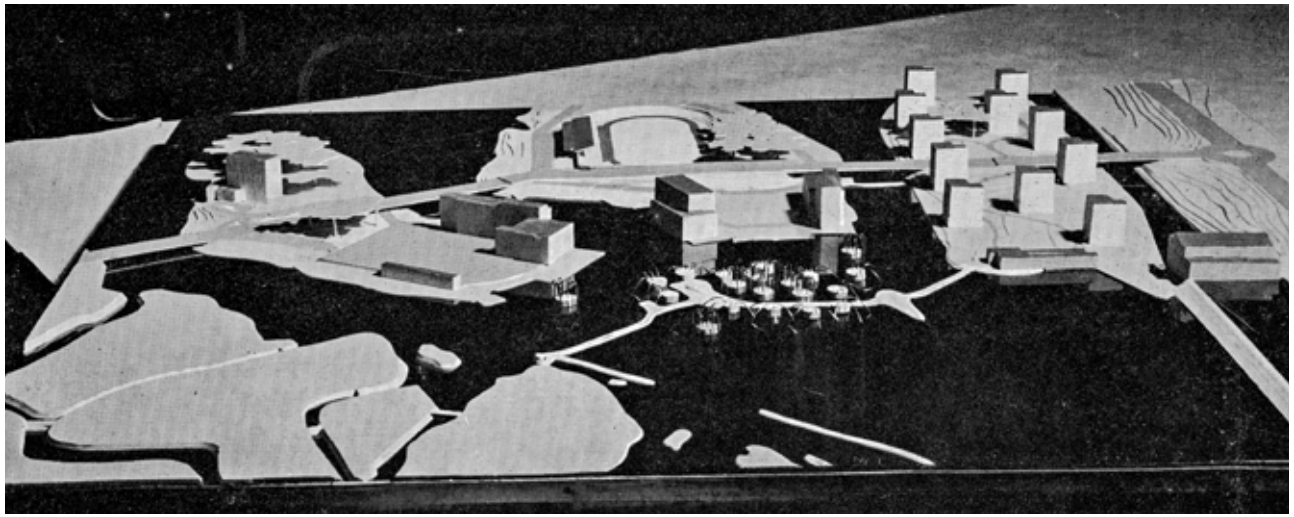
As the board preferred Strömmer's power plant, he was assigned the task of designing the architectural features of the Merikoski power plant.[8]

Aalto realised the potential of the area but also understood the loss that the local community would experience. He understood that the rapids were, and had been, a major part of their local identity. As this would be lost, his proposal would instead create something beautiful as well as practical in return. This was Aalto's humanity in praxis.[9]

Aalto's vision was that the banks of the river, together with the rapids and its islands, would form a "grand Oulu", with Koskikeskus functioning as a connecting element. The area would also be the site of most important monumental and administrative buildings in the city as well as a stadium.

Koskikeskus would be an area of bridges, canals, water, greenery and modern architecture. A green oasis at the hearth of the city.[10] Aalto emphasised that the four islands would form the new city centre with its "municipal, provincial, social and public buildings"[11]. The island were formulated using the excavation masses.

Aalto was always brilliant in pitching his ideas to his clients and this time was no exception. The city's administrative powers were delighted and the plan was approved but was only partly implemented during the 1940s and 1950s, as all of the monumental buildings were never built.[12]



*Aalto, Koskikeskus (1942), scale model. Finnish Architecture Review 1–2, 1943, 3*

At the end, the stadium was placed longitudally, while in Aalto's plan it was transverse. The concrete bridges were built at the end of 1940s. A majority of the apartment buildings and the stadium were designed by Martti Heikura, the city architect of Oulu at the time. Heikura also designed the machine rooms for the regulating dam[13].

Today, Koskikeskus is one of the most charming parts of the city as well as one of the most desired neighbourhoods in Oulu.

*8 Autio 1943, 1*
*9 Krogius 2021*
*10 Aalto explained the overal features of the plan in Finnish Architectural Review 1–2 1943, 2–5*
*11 Aalto 1943, 4*
*12 Krogius 2021*

*13 Krogius 2021*

*Koskikeskus in 1966. Photo: Teuvo Kanerva © The Finnish Heritage Agency*

## Merikoski power plant

Merikoski was a power plant built by the municipality and its primary function was to produce electricity for the City of Oulu. Merikoski is also architecturally different from the other power plants on the River Oulujoki due to its urban environment. Merikoski is located in the heart of Oulu at the mouth of the River Oulujoki. The powerhouse is located between the north bank of the river and the tip of Toivoniemi, an artificial island on the river.

Early calculations indicated that Merikoski would produce more electricity than the city needed. The excess electricity could then be sold to the greater Oulu region. This guaranteed that the power plant would be financially profitable. The most important goal was, however, to attract industry to the area with a reliable electricity supply.[1]

The construction of Merikoski began in the autumn of 1939. It was put on hold due to the Winter War of 1939–1940 but after the peace treaty in 1940, the project resumed construction. The power plant was finished in 1948, with the final sets of machinery beginning to be used in1954.[2]

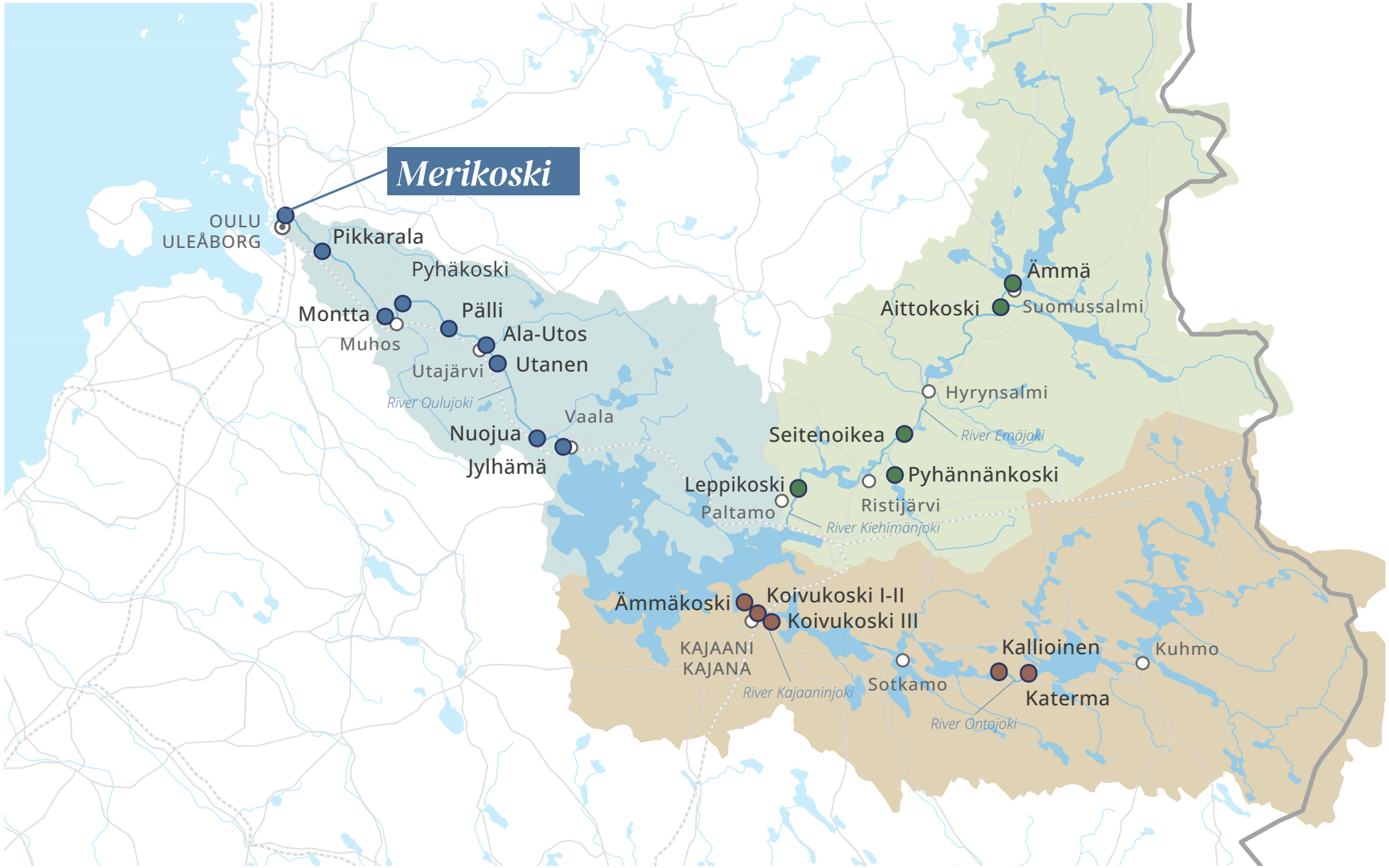
*Merikoski powerplant in Aalto's Koskikeskus plan. Photo © Hotel Lasaretti.*

*1 Enbuske 2010, 314*
*2 Enbuske 2010, 313*

## Technical information

**Power plant type:** Run-of-river
**Contractor**: City of Oulu
**Owner:** City of Oulu
**Built:** 1939–1948
**Architectural design:** Bertel Strömmer, architect
**Structural design:** August Sandsund, Oy Consulting Ab
**Powerhouse:** On-site cast concrete frame, rendered brick facade.
**Machinery:** Three Kaplan turbines with vertical axis and one auxiliary Francis turbine.
**Capacity:** 40 MW
**Head**: 11 m
**Flow**: 240 $m^3/s$
**Dam**: Concrete buttress dam with three radial gates and one slide gate.
**Special features:** Located in the middle of the city, part of Alvar Aalto's Koskikeskus -district, longitudinal buttress dam that divides the river
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Detailed plan

*Merikoski powerhouse seen from the east. Photo:Pekka Elomaa © Council of Oulu Region.*




*Merikoski and Koskikeskus are located in the city centre of Oulu. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement


*Site map of Merikoski. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

The headwater flows into the turbines through the headrace (1). The headwater is separated from the old riverbed by a longitudinal buttress dam (2). The water is impounded in the small forebay (3). The powerhouse (4) is situated between the northern shore of the river and the tip of the island of Toivoniemi.

The switchyard (5) is located on the northern shore. The tailwater is directed into the excavated concrete tailrace (6). The floodwater is then released through the spillway (7) gates into the old riverbed (8) that also has a weir and a group of water fountains. An additional spillway gate (9) is located on Lasaretti Island.

The entire facility is located at the centre of Alvar Aalto's Koskikeskus district.

## Architecture

Strömmer's Merikoski powerhouse is a clear example of his brinkmanship between his earlier classicist tendencies and his curiosity towards functionalism. Blending these two impulses together, Strömmer managed to create a solid piece of clearly articulated modern industrial architecture.

In 1942, the powerhouse was already predominantly designed from a structural point of view. Strömmer's task was to determine the right architectural means for the overall appearance and to integrate the facility into the cityscape. In the Finnish Architectural Review 1–2, 1943, Strömmer explains that:

*"Because of mechanical and electric- technical circumstances, the architect's role will be rather limited in laying out the organisation and the overall masses."*

Comparing the current powerhouse to Strömmer's competition entry from 1942, one can notice certain differences, particularly in the southern façade. The ribbon windows were not realised and the section that connects the powerhouse to the buttress dam has a reduced mass compared to the drawing. Furthermore, the classicist colonnade entrance was not built.

The southern façade forms an interesting ending to the buttress dam. The section that is cladded in natural stone joins the concrete dam elegantly at the base of the powerhouse as the plastered finish intertwines with the headrace. The view from the south also reveals the articulation of the building. The section on the left contains the control rooms, technical spaces and offices. The large section in the middle houses the generators. It also has a chamber

*The power house of Merikoski, south facade. Photo: Pekka Elomaa © Council of Oulu Region.*

that is reserved for control gates, but these were never constructed. Instead, the lower section on the right, next to the headrace, is the main gate hall which contains the radial gates.

The cabin for the fish lift was also constructed and can be seen on the façade. The fish ladder, that runs on the south side of the powerhouse separates it from the park next to it.

The façades both upstream and downstream are sliced by nine vertical ribbon windows that split the eaves line. Dark brown window frames form a continuous line from the eaves to the foundation. The main mass is divided into three monoliths. Each monolith has one turbine as well as submerged gaps for the draft and intake tubes. An additional ice gap was constructed at the north end of the powerhouse. In the early drafts, Strömmer had envisioned brick façades, as had been customary for industrial buildings. In the end, Strömmer decided to use plastered façades to give the powerhouse a more contemporary appearance.

Strömmer also maintained that certain "ruggedness" in the façades would be a "desired attribute", considering the nature and function of the building[1].

It is important to note that while Aalto wanted to emphasise in his proposal that the powerhouse should be designed in a discreet manner and placed in the landscape as unobtrusively as possible[2], Strömmer wanted the facility to be more of a landmark, especially its western façade. The result is, however, that the building is rather unnoticeable in the cityscape.

It is also interesting to compare Merikoski to Strömmer's earlier works. Similarities can be found particularly in the Keskiputous power plant (1932) that was built in Tampere.

*1 Strömmer, 1943, 12*

*2 Aalto 1943, 5*

*The power house of Merikoski seen from the tailrace. Photo: Pekka Elomaa © Council of Oulu Region.*

The machine hall is a clearly composed space with the girder crane running east to west between the gate hall and the coupling machinery. The windows open to the north and south and heavy loads can be moved out by crane through the doors on the north façade.

The electricity is produced by three Kaplan turbines. On the lowest floor of the powerhouse, there is an additional, old Francis turbine, which used to power the auxiliary generator. Today, the auxiliary power is produced by a diesel engine. A large glass maintenance door dominates the northern façade with the girder cranes rails running through the opening.

Compared to the other power plants in the system, Merikoski features a unique gate hall. The radial gates are designed such that the whole chamber can be drained for maintenance. The brick wall and the load- bearing concrete columns between the machine hall and the gate hall are stabilised by a steel grid and additional columns.

The switchyard is also placed near the northern façade and is visible through the glass door. The now demolished, log chute at one time ran past the powerhouse on its northern side and the opening is still visible.

Early calculations indicated that Merikoski would produce more electricity than the city needed. The excess electricity could then be sold to a larger region in Oulu. This guaranteed that the power plant would be financially profitable. The most important goal was, however, to attract more industry to the area with a reliable electricity supply[1].

*The machine hall at Merikoski. Photo: Pekka Elomaa © Council of Oulu Region.*

Today, the Merikoski power plant remains important as a source of regulating power, particularly for wind energy. The fish ladder was constructed in 2003. It is the longest fish ladder in Finland as well as the only one in the River Oulujoki.

*1 Enbuske 2010, 314*

# 5.1.2 Pyhäkoski

Located in the municipality of Muhos, the rapids of Pyhäkoski served as the starting point for the whole project because it was the first power plant that the Oulujoki Power Company built. In the 1930s and 1940s, the rapids of Pyhäkoski became one of Finland's most popular sights as well as one of the first commercialised tourist attractions

Aarne Ervi and his office were responsible for the architectural design while the structural design was made by Osmo Korvenkontio, Veli Lehtonen, Juhani Kilpeläinen, Harri Sistonen and Ilkka Paaja. The environment and the terrain had a significant impact on the disposition and preconditions of the overall design. At the construction site, the rapids of Pyhäkoski ran through a deep canyon, and this gave the powerhouse its tall, vertical shape. In addition, a power plant situated in this manner needed no additional channels. During the design, factors that needed to be considered concerned the functional end result as well as the current technical possibilities and limitations. At the same time, Ervi had to conceive of the power plant as a part of the larger system.

These were the conditions and premises when Ervi and his office began their work. They set high architectural goals and the world was going to witness their results. The construction of the power plant began in February 1941 during the interim wartime peace. This meant that resources were scarce. At that time, Finland had little to none of the materials, machines and workforce that were needed to build a large power plant in the wilderness. In 1941, regulation began on the water level of Lake Oulujärvi.

In the 1940s, everything that was heavy travelled by rail, which meant that railroad tracks had to be laid on site. This made it possible for the turbines and generator to be transported from southern Finland to Pyhäkoski and straight into the powerhouse.

When the war ended, during the autumn of 1944, construction resumed. The rationing of materials continued to slow down construction, but the situation was progressing. Anything that could not be purchased had to be built. In the workshops, company blacksmiths built everything from tools to railroad cars. During 1947, conditions improved and the workforce shortage eased. At that time, an average of 1,205 to 1,295 builders worked on the construction site.[1]

After the concrete work for the forebay was completed in 1948, the water could be raised to its full regulation height of 32 metres. The machinery was installed after this. The first set of machinery was connected to the power grid in April 1949, the second and third ones in 1951. Log running was made possible by building a log chute on the west bank of the river.[2]

The lower floors of the powerhouses service area were reserved for operational management. Other power plants were also designed in these offices. In addition, Pyhäkoski functioned as a central construction hub for the two other power plants, Montta and Pälli.

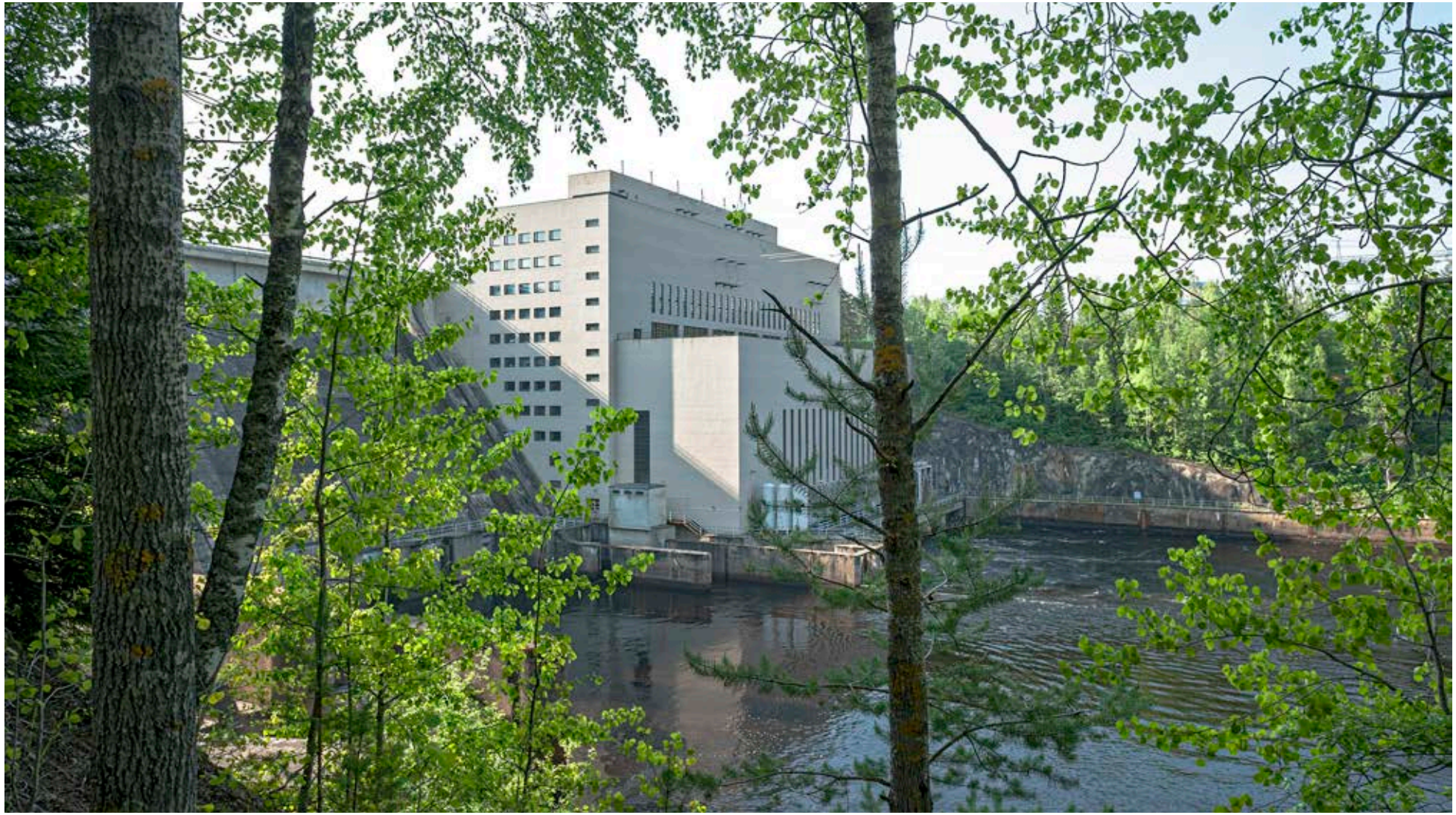
*1 Enbuske 2010, 314*
*2 Ibid*

This meant that temporary living quarters, a power station, a repair shop and a sawmill needed to be built.

The large residential area of Pyhäkoski, called Leppiniemi, was finished at the end of the 1950s and the beginning of the 1960s. The regional office of the power company was built in Leppiniemi in the 1990s. Pyhäkoski is currently the fourth-largest hydroelectric power plant in Finland.

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1941–1951
**Architectural design:** Aarne Ervi, architect
**Structural design:** Osmo Korvenkontio, Veli Lehtonen, Juhani Kilpeläinen, Harri Sistonen, Ilkka Paaja
**Machinery:** Three Kaplan turbines with a vertical axis
**Capacity:** 147 MW
**Head**: 32.3 m
**Flow**: 450 $m^3/s$
**Powerhouse:** On-site casted concrete frame, rendered brick facade.
**Special features:** Leppiniemi guesthouse, hydropower museum.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes), Docomomo site.
**Zoning status**: Detailed plan

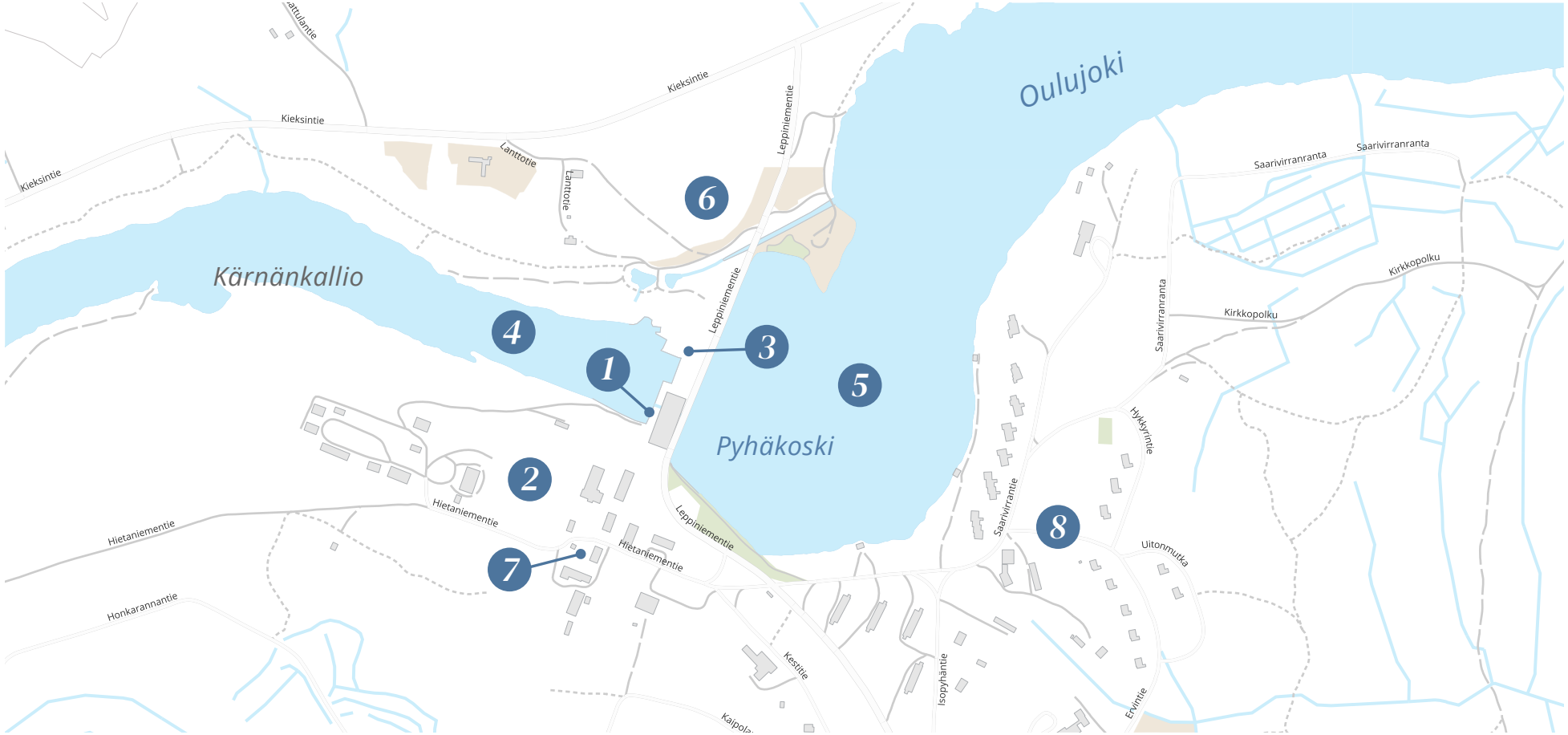


*Pyhäkoski powerhouse seen from the north. Photo: Pekka Elomaa © Council of Oulu Region.*

## Location


*Pyhäkoski is located in the municipality of Muhos about 35 kilometres southeast from Oulu. The city centre of Muhos is located approximately eight kilometres south of Pyhäkoski.*
*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement



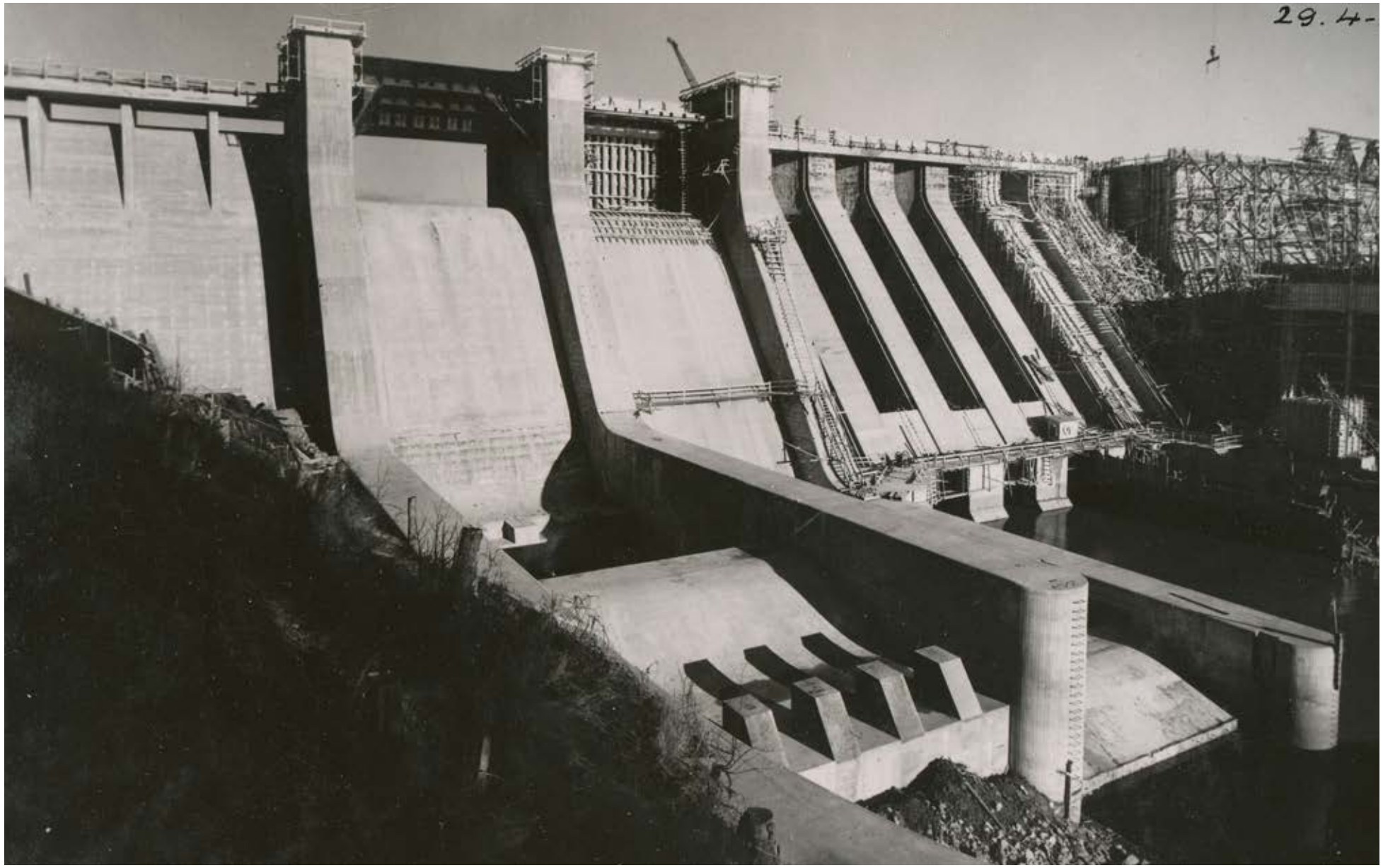

*Site map of Pyhäkoski. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

The powerhouse (1) is built straight in to the river and onto the bedrock. The switchyard (2) is located on the south bank of the river. The regulating dam (3), located on the north side of the powerhouse, has two spillways equipped with radial gates.

The floodwater is released straight into the old riverbed that functions as a tailrace (4). The headwater runs into the turbines from the forebay (5) through the control gates. Tailwater discharges from the draft tubes into the tailrace.

Part of the old, concrete, log-chute still remains as well as the frame of the girder crane, that was used to lift the log rafts over the dam (6). The large service area with storages (7) was built next to the powerhouse. The residential area (8) is located on the other side of the forebay.[1]

*1 Myllykylä 1995-1999, 72*




*Pyhäkoski in 1948. The power house is under construction. Photo: Foto Roos © Fortum Power and Heat.*

*Men standing in the intake gap of the Pyhäkoski powerhouse. Photo: Foto Roos © Fortum Power and Heat.*


*The machine hall of Pyhäkoski under construction. Photo: Foto Roos © Fortum Power and Heat.*

## Architecture

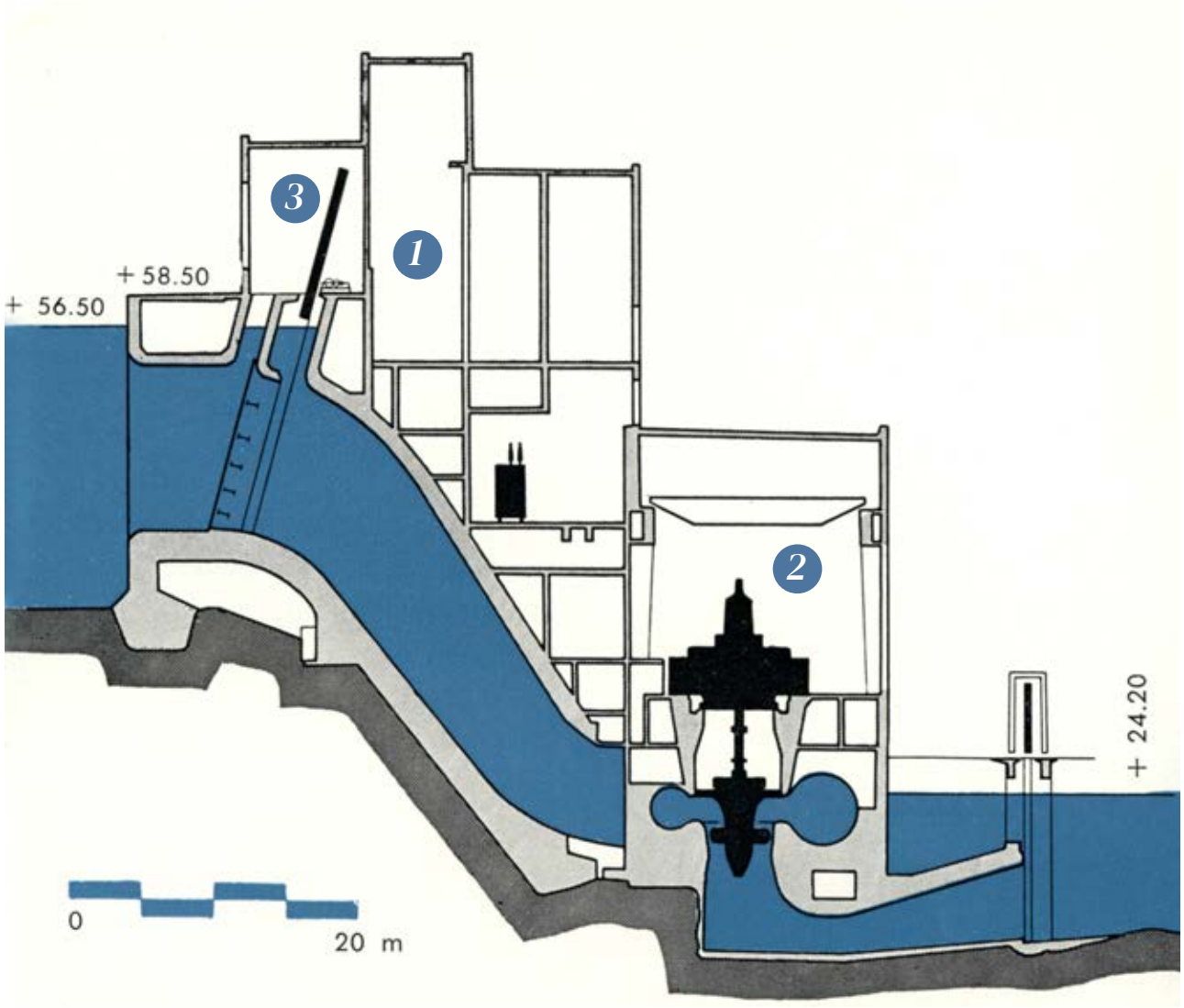
The powerhouse of Pyhäkoski is considered one of Aarne Ervi's most important works. It has often been referred to as "the most beautiful hydropower plant in Finland". Pyhäkoski as well as Jylhämä represent the first phase in the evolution of Ervi's hydropower architecture.

In Pyhäkoski, Ervi formulated a rectangular, monumental mass that sits on the riverbed. The building has functionalistic overall features and platonic façades that communicate the goals and objectives of the industrial architecture and high modernism of that era. To this day, it is an assertive display of technology triumphing over nature.

The turbines are placed deep at the bottom of the canyon, while the indoor switching plant and the high voltage transmission lines sit on top of the building, above ground level.

This arrangement resulted in the mass of the building having a vertical overall appearance and the powerhouse resembling a 12-story apartment building built right on the river. The head, 32 metres, is significant for Finnish rivers. The fact that the construction site dictated the arrangement of the functions, which in turn dictated the buildings form is, of course, quintessential functionalism.

*The Pyhäkoski powerhouse, the north facade. Photo: Pekka Elomaa © Council of Oulu Region.*




A section of the Pyhäkoski powerhouse. © Fortum Power and Heat.

Pyhäkoski powerhouse consist of four rectangular blocks that amalgamate elegantly to each other. The powerhouse joins the regulating dam, together forming a “grand object” that closes the channel completely.

The bottom of the dam is almost as wide as the powerhouse structure. High voltage transmission lines sit on top of the building. Below this is the indoor switching plant (1). The large windows of the control room open toward the tailrace over the roof of the machine hall, inviting daylight and greenery into the building. The machine hall (2) sits at the bottom, while the gate hall (3) is located next to the switching plant.

In a structural sense, Pyhäkoski is a masterpiece in concrete casting. Its massive regulating dam, spillways and the frame of the powerhouse represent the finest of concrete casting on a massive scale. The concrete laboratory was founded in Pyhäkoski in 1938 and the company engineers had meticulously researched the materials performance in the arctic conditions of Northern Finland.

The result is that the fair-faced and raw concrete casts, now 80-years-old, are still in good condition, despite the rugged weather and the strenuous effect of water pressure.

The façade on the side of the headrace conveys a certain calm serenity. The roaring rapids have been replaced by the forebay where the water appears almost motionless. The eastern façade of the powerhouse reflects the surface of the water, revealing the complete transformation of the environment.

The dam bridge crosses the forebay on the eastern side of the powerhouse. Next to the bridge, the gate hall stands out as a separate block. Behind the gate hall stands the narrow and tall block that houses the indoor switching plant. The high voltage transmission lines sit on top of that block and connect the building to the switchyard as well as to the national grid.

*The Pyhäkoski powerhouse as seen from the forebay. Photo: Pekka Elomaa © Council of Oulu Region.*

The view from the tailrace is Ervi's industrial vision carved out of stone, concrete, plaster and brick. The tectonics of the powerhouse present itself clearly. The façade, with its narrow tall windows, is vertical in a static and monumental sense.

The roof of the machine hall connects into the upper mass, as the windows function as a connecting element. The southwest corner of the machine hall is supported by the bedrock that also forms the supporting structure for the tailrace. The regulating dam and the spillways block the other side of the channel.

*Pyhäkoski powerhouse seen from the tailrace. Photo: Pekka Elomaa © Council of Oulu Region*

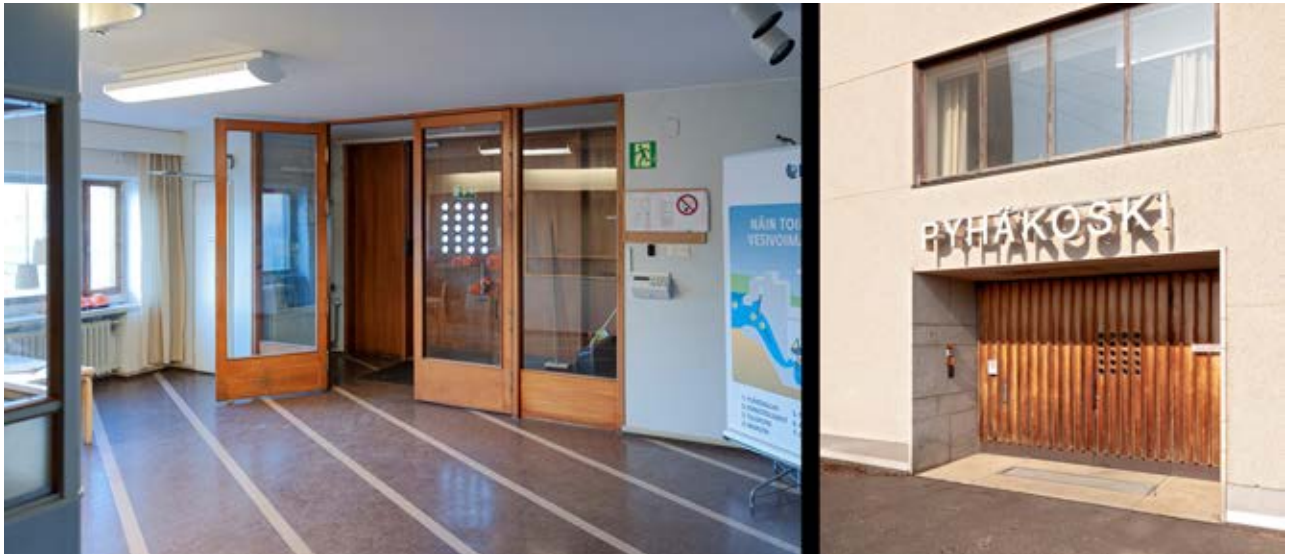
As Pyhäkoski was to become the crown jewel, the interiors were also meticulously planned.

From the dam bridge, the main entrance is accessed from the dam bridge at the north end of the building. The office floors are connected by a closed riser stair. Other stairs spiral around the lift shaft almost as if defying gravity. Ervi often incorporated stairs and staircases into his power plant design and he did this in part to emphasise the possibilities of concrete buildings.

These staircases connect the different functions of the building, but most of all, tie together the four-section building mass as a coherent piece of industrial architecture.

This serene industrial building, uncompromising in its proportions, warmly greets its visitors as they grasp the handle of its oak door. The office block also has a pleasingly humane scale and its details are carefully designed.

*The stairwell of Pyhäkoski powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*




*The main entrance of the powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

In the machine hall, the focus is quickly drawn to the massive columns and the quality of the concrete work. The main feature in a functional sense remains the generators, which have been painted red. The rails lead into the service level, which means that the generators can be moved in and out when necessary. The machine hall has two 120-ton cranes[1]. The tall, cathedral-like space receives ample natural light from the vertical windows. The original electric lights are placed on the ceiling and at the bottom of the main supportive beam. Unfortunately, new lights were added later to the lower part of the exterior wall. This intersects the space and severely undermines the vertical sensation one experiences when entering the hall.

In addition to producing electricity, Pyhäkoski had a more extensive "mission". During the 1940s and 1950s, Finland was undergoing a transformation in many ways. The agrarian and rural society of the past decades was about to be transformed into a modern country and architects and engineers such as Aarne Ervi and Niilo Saarivirta were at the helm of this process. Pyhäkoski was going to communicate this change and symbolise technological progress, industrialism and a better, more prosperous future. For its part, it was also meant to be evidence that Finland belonged among modernised and industrialised western countries.

Owing to its presence, size and modernity, Ervi's powerhouse in Pyhäkoski was considered to be "the Flagship of Oulujoki". Architecturally, it represent the highest point in Ervi's monumental impulse and his expression of structural logic.

*The Machine hall of Pyhäkoski powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

It was also an important phase in the development of Finnish modernism and industrial architecture.[2]

After Pyhäkoski and Jylhämä, Ervi began to experiment with new innovations, such as standardisation, precast panels and metal sheeting. He also searched for different motifs and forms in his forthcoming power plants: Pälli, Nuojua, Montta and Utanen.

*1 The Oulujoki Power Company 1959, 11*

*2 Myllykylä 1995-1999, 29*

## Residential area

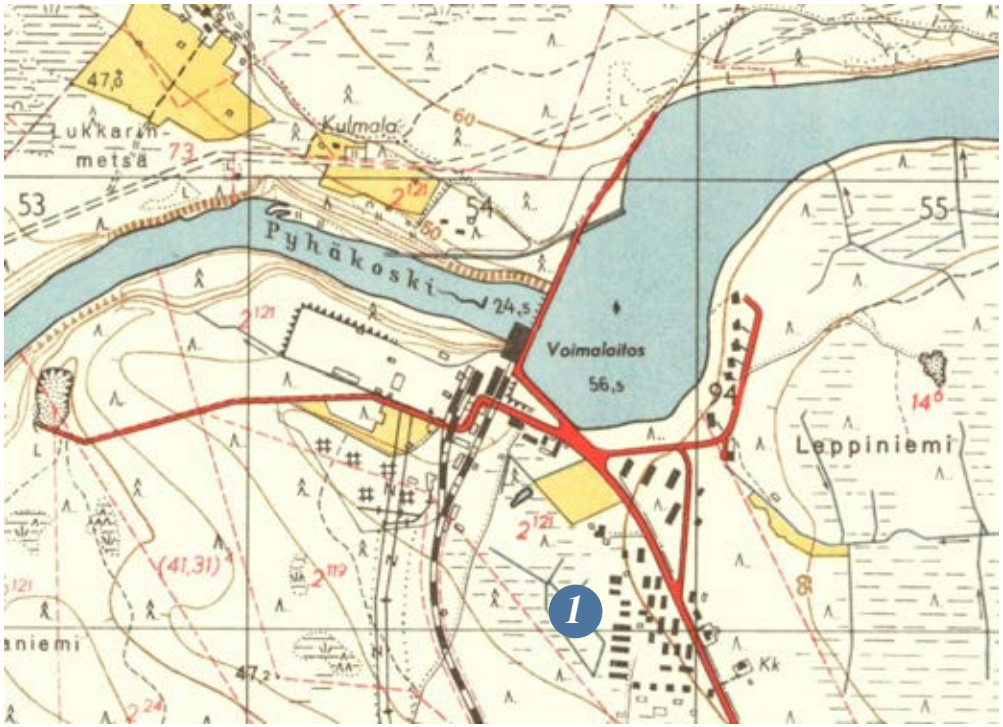
The residential area of Pyhäkoski, called Leppiniemi, is one of the largest residential areas and communities, completed during the project.

Leppiniemi features several house types and it was allmost a self-sufficient, village from the 1940s until 1960s. Although it's population is today significantly lower, than it used to be, most of Leppiniemi's houses are still inhabited and it is a respected neighbourhood of Muhos municipality.

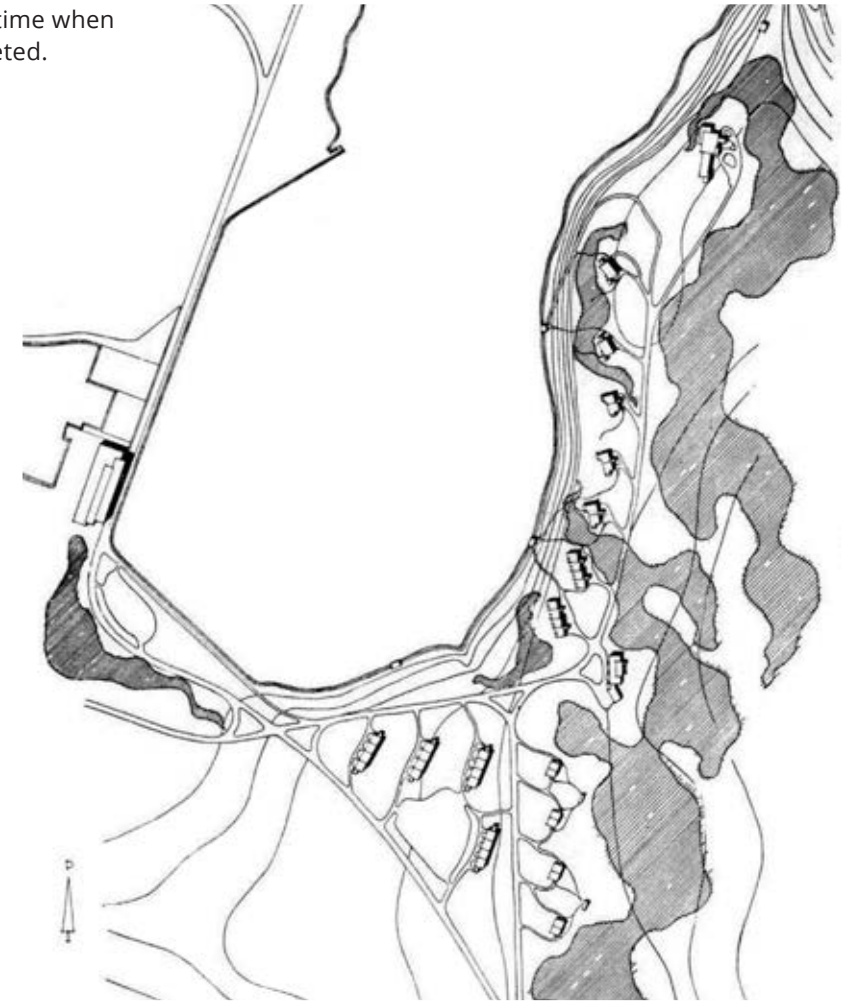
Leppiniemi has undergone several phases during its history. It functioned as a central construction hub for the lower reaches of the River Oulujoki consequently had a large community, many temp-orary buildings and barracks. The barracks area (1), which has since been demolished, can be seen on the map on the left, on the west side of Leppiniementie -road. The map is from the early 1950s, the time when the power plant had just been completed.

The map on the right is from Finnish Architectural Re- view 11–12, 1949.

It shows the oldest part of the area, built between 1940–1944. The temporary buildings are not shown on the map even though they still existed in 1949. The map on the next page illustrates the current situation in Leppiniemi.




*Leppiniemi in the early 1950s. Map: National Land Survey of Finland*



*Leppiniemi in 1949. Ervi's site map from Finnish Architectural Review 11–12/1949*

The buildings with red roofs on the map mark the oldest layer in the area's history (1940–1944). This part of the area includes the row houses (5 & 11) and detached (2) and semi-detached houses (3) along the waterline. The most prestigious of all the buildings in Leppiniemi is the guesthouse (1) that was finished 1948.

Leppiniemi also provided all the necessary services for its residents. During the 1940s, a general store and a post office/barber shop (15) were built. The police station and shop keepers house were also built, but these buildings have now been demolished. The school of Leppiniemi burnt down in 1973 and all that remains now is the teachers' dormitory (16). A service building (7) was built in the centre of the area. This building functioned as a laundry room, a bakery and as a garage. The building also had a boiler room which provided the necessary heating for the houses.

This newer section of the area (the buildings with white roofs) was finished at the end of the 1950s and early 1960s. This "new residential area", as Ervi called it, includes ten detached single-family houses (6) and six apartment buildings (13). The clubhouse, also designed by Ervi, was completed in1962. The control room building, one of Ervi's last works, was finished in 1977. In 1991, the Oulujoki Power Company built a regional office between two of the apartment buildings (12). This office was designed by the architecture office of Erik Kråkström.

When planning Leppiniemi, Ervi had two reference points in mind. One was Alvar Aalto's Sunila, an industrial community built in Southern Finland in the 1930s, and the other reference point was the pre-industrial forge-communities. In Leppiniemi, Ervi combines Sunila's high-quality housing with the social hierarchy of the forge communities[1].

*1 Huhmo 2015, 43-44*

Currently (2021) there are 43 buildings in Leppiniemi and an addition to this, several yard storage spaces.

Guesthouse (1)

Twelve detached single family houses (2 & 6)

Five semi-detached two family houses (3 & 10)

Six row houses (5 & 11)

Four saunas (4)

Two commercial buildings, a post office and a general store (15)

Teacher's dormitories (16)

Six apartment buildings (13)

Three garages (8 & 14)

Service buildings (7)

Regional office of the Oulujoki Power Company (12)

Clubhouse (16)


*Leppiniemi residential area. Map: Veli-Pekka Huhmo.*

The architectural language of the Leppiniemi houses follows the style of romantic functionalism that was rather popular in Finnish architecture in the 1940s[1]. This meant a modernist programme combined with vernacular features – roof shapes and mate rials – such as wood, slate and brick[2].

At Leppiniemi, Ervi strongly emphasized the disposition of the buildings. The line of houses following the waterline north in- cludes two terraced row houses, three semi-detached houses, two detached houses and the guesthouse at the end of Saarivirrantie road. All these buildings have the same structural elements and materials. The frames are made of lightweight concrete blocks called Betocell. The facades are plastered brick but partly wood and have been enlivened by natural stone.

These houses also have gently sloping hipped tile roofs and concrete foundations. The porches open up to the surrounding landscape, giving the buildings a serene overall atmosphere. These houses were built in the early 1940s for the high-ranking employees of the company, the officers and engineers. These buildings have a beautiful prospect across the forebay and to the power plant. The landscape also has a park-like atmosphere. In addition, log-constructed saunas were built along the shoreline.

*Row house of Pyhäkoski. Ervi placed the Building in the shore of the forebay. Photo: Pekka Elomaa © Council of Oulu Region.*

*The Engineer's house in Leppiniemi, a luxurious single family house designed by Aarne Ervi. Photo: Pekka Elomaa © Council of Oulu Region.*

*1 Makkonen 1994, 26*
*2 Huhmo 215, 41*

*The horizontal shape of the guesthouse. Photo: Samuli Paitsola © Council of Oulu Region.*

Ervi's most prestigious houses in Leppiniemi are executed in an almost Wrightian panache. This is evident by the vertical organic forms of the buildings and in the warm details. The guesthouse of Leppiniemi is probably the finest example of this impulse. It could also be seen as the most important building that has been built in the residential areas.

Archival evidence reveals that Ervi drafted several proposals for the guesthouse but in the end, he formulated a five-bedroom house, with a large dining hall, a lounge and porches at each end of the building.

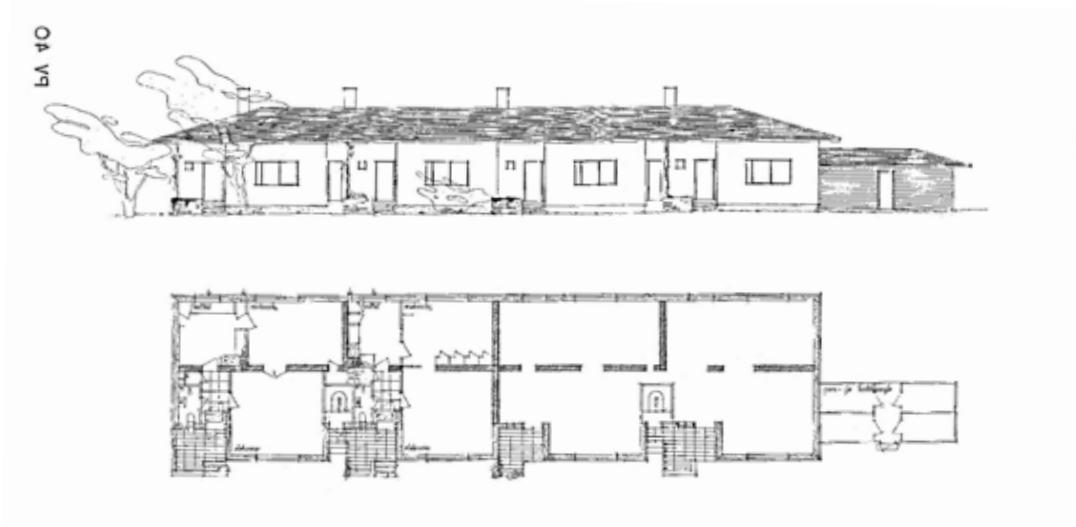
The building was furnished with Aalto furniture as well as lights by Paavo Tynell. Over the years, the building has hosted many important guests, including several presidents. The buildings has also been meticulously maintained and is in good condition. The guesthouse currently provides tourism services.

At the centre of the area stands a group of four row houses that were built in the early 1940s. Each unit could house four families. These buildings have one floor as well as a spacious basement. The apartments were smaller and built for the workers.

These houses were nonetheless constructed with high-quality standards and had luxuries such as showers, which was a rare feature in a housing unit of the 1940s. At present, the houses are only partially inhabited but remain in relatively good condition.

The interiors have undergone several transformations, which is common for houses of this age. This is because the current protection regulations only apply to the exteriors of the buildings. On the right, Ervi's original drawings for the row houses.

*A row house at Leppiniemi, Photo : Kirsti Reskalenko © Council of Oulu Region.*



*Ervi, Leppiniemi row house, west elevation and a ground plan.. © Fortum Power and Heat.*

*A two family semi-detached house. Photo: Pekka Elomaa © Council of Oulu Region.*

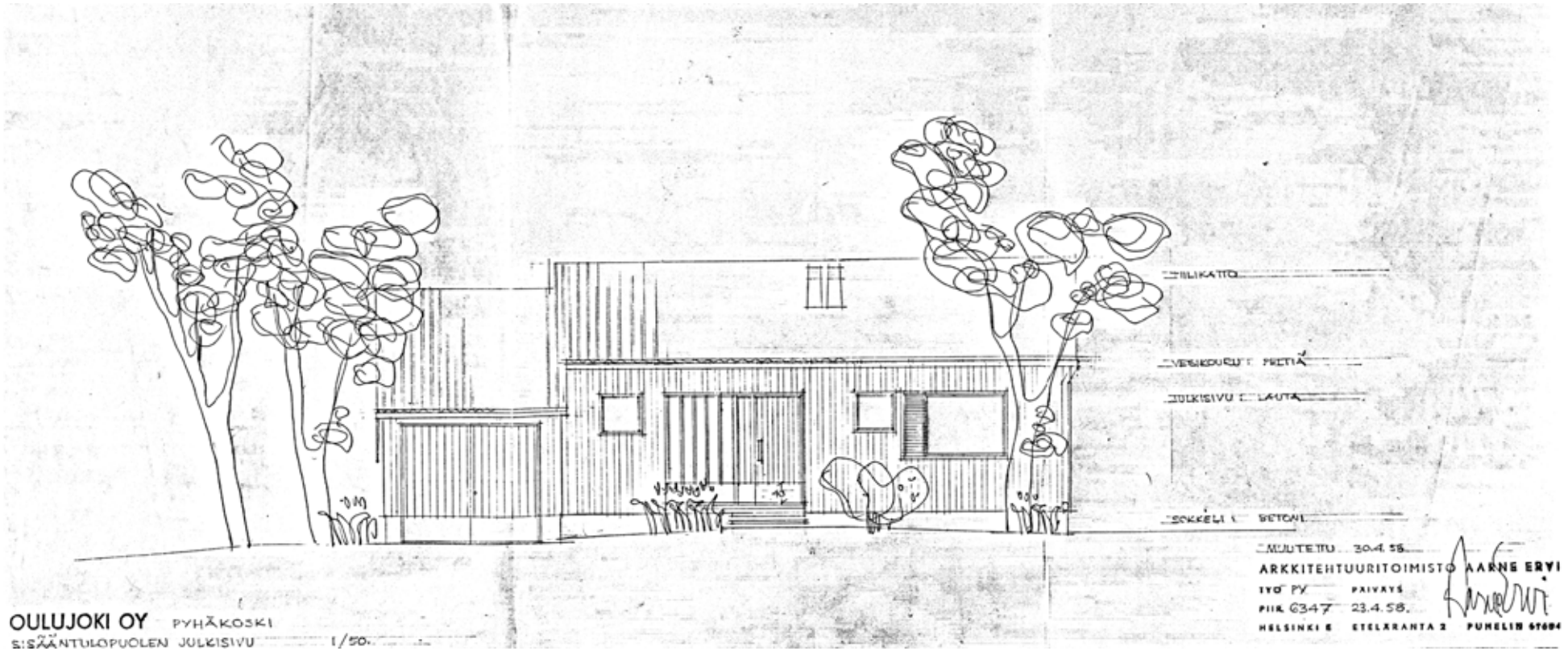
Even though the main office of the Oulujoki Power Company was located in Helsinki, many local operations were coordinated from Pyhäkoski. For this reason, in the late 1980s, the company decided to build a regional office in Leppiniemi.

At the time, the architectural office of Erik Kråkström was in charge of designing the new corporate architecture for the company. Kråkström's office was assigned the task of building a new office between two of the apartment buildings and connecting the different elements with corridors.

The complex was completed in 1991. The overall design of the regional office blends successfully with Ervi's earlier vision of creating a sleek, modern office building that is situated at the heart of the residential area. This building is no longer in use and is in need of maintenance.

*The regional office. Photo: Samuli Paitsola © Council of Oulu Region*

*The regional office during winter. Photo: Kirsti Reskalenko © Council of Oulu Region.*




*Ervi, Leppiniemi residential area, type house B3, east elevation. © Fortum Power and Heat.*

In Leppiniemi, Ervi used three wooden type houses. These were types B3, B4, and A3, which is a larger version and has three bedrooms. These houses were built at the end of the 1950s and are situated in the eastern part of the area.

Ervi's draft from August 1958 reveals he planned to build 19 of these types of houses, but in the end only ten were built[1].

At the end of the 1950s, two other power plants and residential area were also under construction, Ämmä and Seitenoikea. It was here that Ervi used the same type houses with the exception that in Seitenoikea he used types B5 and B6, which were mirror images of Leppiniemi's type houses.

These wooden houses were constructed with a balloon frame and had a board and batten cladding.

The roofs are built out of fibre-reinforced cement board.

Additional insulation was added later to these houses. This has slightly altered their overall appearance.

*1 Ervi's draft for the "New residential area for Pyhäkoski power plant" dated 31.8.1958 © Fortum Power and Heat*

*Ervi's type house B3 in Leppiniemi. Photo: Kirsti Reskalenko © Council of Oulu Region.*

*Apartment buildings in Leppiniemi. Photo: Kirsti Reskalenko © Council of Oulu Region.*

Ervi was informed in 1957 that the most qualified workers were still living in temporary barracks and under poor conditions. Ervi's office quickly designed wooden detached type houses and small apartment buildings for these people[1].

The apartment buildings were finished by 1961. These apartments were of course a huge improvement in living conditions compared to the barracks. These buildings have two floors for dwelling as the ground floor is reserved for storage and garages. Each block also had an individual yard storage. One of the buildings featured a kindergarten on the ground floor.

These buildings were constructed with plastered concrete frames. These buildings are currently mostly uninhabited. This unfortunately means that the buildings have begun to deteriorate but are still salvageable.

*Balconies of the apartment buildings in Leppiniemi. Photo: Samuli Paitsola © Council of Oulu Region.*

*Children of Leppiniemi's kindergarten. Photo: Unknown*

*1 Hakkarainen 1994*

The planning of Leppiniemi follows the common social hierarchy of the past that was adhered to especially by the pre-industrial forge communities of Finland. This meant that the disposition of the area was to emphasize the authority of the leading figures and that the different social groups were segregated.[1]

Towards that end, the largest and more luxurious houses were reserved for the executive branch and for the officers, while the workers lived elsewhere. In Leppiniemi, these two areas were also separated by what is referred to in Finnish as a ”sosiaali-oja” (a social ditch). This was a symbolic but a concrete boundary and it was considered to be highly inappropriate for a worker or a member of his family crossed this without invitation or permission.

The common rule in Leppiniemi was that workers lived in row houses or more modest wooden semi-detached houses, as indicated in the picture as well as in apartment buildings. Meanwhile, the officers and engineers resided in more luxurious semi-detached or detached houses.

Leppiniemi also had greenhouses, waterfront saunas a tennis court, and during the winter, a skating rink.

*Along the Isopyhäntie -road, Ervi drew wooden semi-detached two family houses. These houses are more traditional in their architectural language.*
*Photo: Pekka Elomaa © Council of Oulu Region.*

*1 Makkonen 1994, 28*

The service building in Leppiniemi was one of the most important buildings in the area. It functioned as a laundry room, as a bakery and also had four garages. The building also had a boiler room and provided heat for the houses during the cold winter months. Ervi designed the building with architectural features familiar to the area and placed it at the center of the plan, at the intersection of three roads that cut through the area.

The old clubhouse of Leppiniemi burnt down in February of 1960. This building followed the same design principles as the old houses in Leppiniemi. The clubhouse was also an important building because it housed all the social gatherings of the community.

After the fire, Ervi immediately designed a new clubhouse and the construction began in the same year. The building was finished late in 1962. Here Ervi's design is rational, tempered, structural and emphasizes materials. The building design thus follows the general features of Finnish architecture in the 1960s. Ervi also saw this as an opportunity to modernise a building type that was considered to be old-fashioned[1].

In many ways the building can be considered a counterpart to the guesthouse as well as a part of the social hierarchy of the area.

While the guesthouse was a lounge for the important company guests, the clubhouse was for the working man.

Today, this building is no longer in use and according to previous users, suffers from poor indoor air quality. The building is still owned by Fortum Power and Heat but its future remains uncertain.

*The service building of Leppiniemi. Photo: Pekka Elomaa © Council of Oulu Region*

*The Leppiniemi Clubhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

*1 Huhmo 2015, 59*

*The control room building in Pyhäkoski was one of Ervi's last designs. Photo Unknown © Fortum Power and Heat.*

One of Ervi's last works was the new Pyhäkoski control room building. It was completed in 1977, the same year Ervi passed away.

The building is currently in use and owned by Fortum. Architecturally, the building has Ervi's typical features: a horizontal and modern overall appearance that has been softened by traditional material such as brick and wood.

The building exterior is rather modest but the interiors were refined and executed with high-quality materials and an attention to detail.

*The interiors of the control room building were executed with high quality materials and attention to detail. Photo Unknown © Fortum Power and Heat.*

As Pyhäkoski functioned as a central construction hub for the lower reaches of the River Oulujoki, a large service and construction area was built. This area contains a repair shop, several warehouses and a switchyard. The company's concrete laboratory was also situated in the service area and was a key component in the development of concrete construction. The service area was also designed by Ervi and his office. This service area is still used by Fortum, but the concrete laboratory is no longer in use.

*The service area of Pyhäkoski. Photo:Pekka Elomaa © Council of Oulu Region.*

# 5.1.3 Jylhämä

In 1946, only two power plants were under construction along the River Oulujoki, Merikoski and Pyhäkoski. After the war, Finland suffered from a shortage in electricity and it was therefore urgent to launch new hydroelectric projects. Jylhämä is the first power plant on the River Oulujoki that flows from Lake Oulujärvi to the Baltic Sea. It also functions as a regulating dam for the lake. Jylhämä was built by the Oulujoki Power Company and Aarne Ervi was responsible for the architectural design.

In the mid-1940s, it was decided that the rapids of Niskakoski, in the municipality of Vaala, were to be divided between two power plants. The plan was for Jylhämä to be built upstream and Nuojua at the lower part of the rapids.[1] Jylhämä was designed to function as a regulating dam for Lake Oulujärvi. This meant that the water level for the reservoir would be the same as the water level of the lake. The regulation level for Lake Oulujärvi was set at 123.2 metres above sea level.[2]

The construction began during the summer of 1946. Jylhämä was to be built in the middle of wilderness and the area had neither modern roads nor housing. This meant that the first year and a half was spent setting up a modern builder community. To ensure that the builders would have enough timber, the Oulujoki Power Company purchased the Vaala Sawmill that was located nearby.[3]

The main obstacles in building Jylhämä were related to earthmoving and excavating. Due to shortages after the war, machines were not available and most of the work had to be done manually. The situation improved in 1948 and subsequently, most of the work could be carried out by machines.[4]

To construct the earth fill dams and to dig the canals, a total of 1.5 million cubic metres of earth needed to be removed. This meant that Jylhämä was, at the time, the second-largest earth-moving job in Finnish history. At its busiest, over 2,000 workers and dozens of machines were employed at that construction site.[5] These large earthmoving works and long embankments altered the landscape in Jylhämä significantly.

At the same time, the powerhouse and the concrete dam were under construction. A concrete mixing plant was also constructed on the south shore. The powerhouse was built with an in-situ concrete frame, plastered brick façades and horizontal windows. Turbines had been ordered from Tampella and the generator from a Swiss company, Oerlikon. The first set of machinery was connected to the power grid on 19 June 1950, the second on 3 December 1950 and the third on 30 December 1951.[6] The power plant has a maximum capacity of 55 megawatts.

### Technical information

**Power plant type:** Impoundment
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1946-1951
**Architectural design:** Aarne Ervi, architect
**Structural design:** Osmo Korvenkontio, Veli Lehtonen, Juhani Kilpeläinen, Harri Sistonen, Ilkka Paaja
**Machinery:** Three Kaplan turbines with a vertical axis
**Capacity:** 55 MW
**Head**: 11–14 m
**Flow**: 400 $m^3/s$
**Powerhouse:** On-site casted concrete frame, concrete panel facades with steel sheeting
**Special features:** Open-air museum, Uutela farm, regulates the water lever of Lake Oulujärvi.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes), Docomomo site
**Zoning status**: District plan

*1 Kuuskoski 1991, 27*
*2 Enbuske 2010, 315*
*3 Kuuskoski 1991, 28*

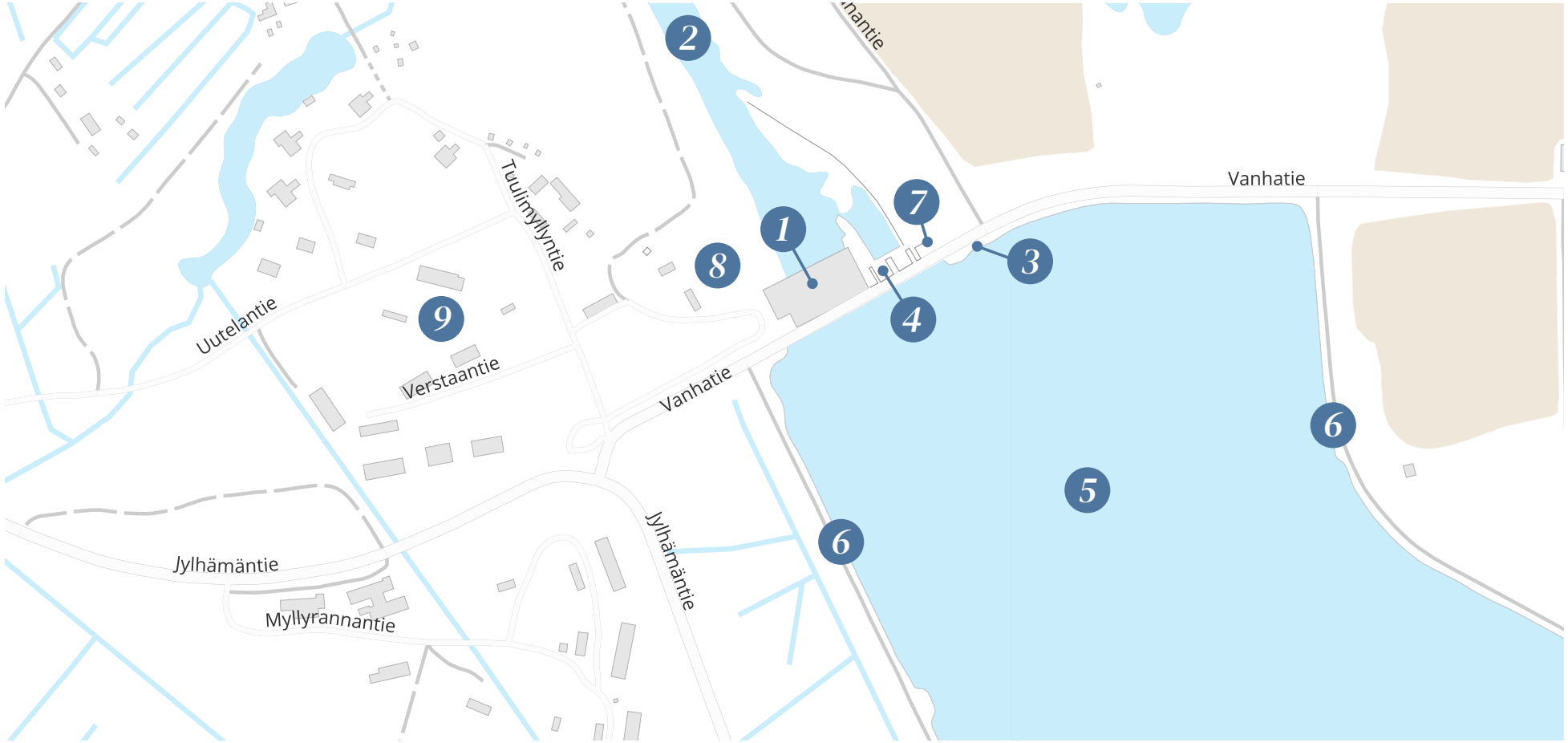
*4 Enbuske 2010, 316*
*5 Kuuskoski 1991, 35*
*6 Ibid, 36*

*The powerhouse and regulating dam of Jylhämä. Photo: Pekka Elomaa © Council of Oulu Region.*

## Location


*Jylhämä is located along the River Oulujoki in Vaala municipality about 4 kilometres from the Vaala city centre and approximately 88 kilometres southeast of Oulu.*
*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement




*Site map of Jylhämä. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

The powerhouse (1) was built on the western side of the riverbed. The long tailrace (2) was excavated through the neck of land. The river was then closed by an embankment (3) and by a regulating dam (4) and the water was directed to flow through the power plants turbines. The regulating dam has two spillway openings equipped with radial gates. Today, the old riverbed is completely dry and overgrown and is no longer visible in the landscape. The impounded water is stored in a small forebay (5) that is flanked by long embankments and earth dams (6). The log crane (7) was built on the eastern side of the plant. The concrete frame of that crane remains to this day. The switchyard (8) is located on the western bank of the tailrace. The large residential area (9) with a separate service area was built on the western side of the facility.


*A foreman observing the excavations at the Jylhämä construction site. Photo: Foto Roos © Fortum Power and Heat.*


*Jylhämä in the summer of 1949. The water is flowing through the regulating dam. The powerhouse is still under construction. Photo: Foto Roos © Fortum Power and Heat.*

## Architecture

Jylhämä was built at the same time as Pyhäkoski, but while Pyhäkoski was constructed in a deep canyon, the building site in Jylhämä was exceedingly flat. As a consequence, in addition to the tailrace, which was 2.5 km long, large embankments had to be created for the facility to have sufficient head. The powerhouse and the regulating dam were built between the embankments and a concrete log chute was built between them. The one remaining log chute in Jylhämä is the only surviving chute of the power plants constructed on the Oulujoki waters. A log crane was built later.

Looking at the building from the north, from the east bank of the tailrace, the building presents itself clearly. From this vantage point, one can observe that the absence of elevation in the terrain leads to the horizontal and rectangular overall mass of the powerhouse. The façade is dominated by the large windows of the transmission gear chamber between the rendered finish. The office section is located at the northeast end and is clearly visible in the overall composition as a separate block. The offices also have windows that open toward the tailrace.

The bridge on the tailrace and the draft tube gate are built straight into the façade. The gate and its machinery are supported by a five-metre-tall concrete slab and with the bridge running across the tailrace. The machine hall is placed behind the transmission gear chamber. The machine hall also opens up towards the regulating dam through a large window in the northeast façade. Next to the dam bridge is the gate hall, which is the tallest mass in the building. In terms of the overall composition, the tall concrete walls separate the outflow channel of the regulating dam from the tailrace, while the switchyard can be seen on the western shore.

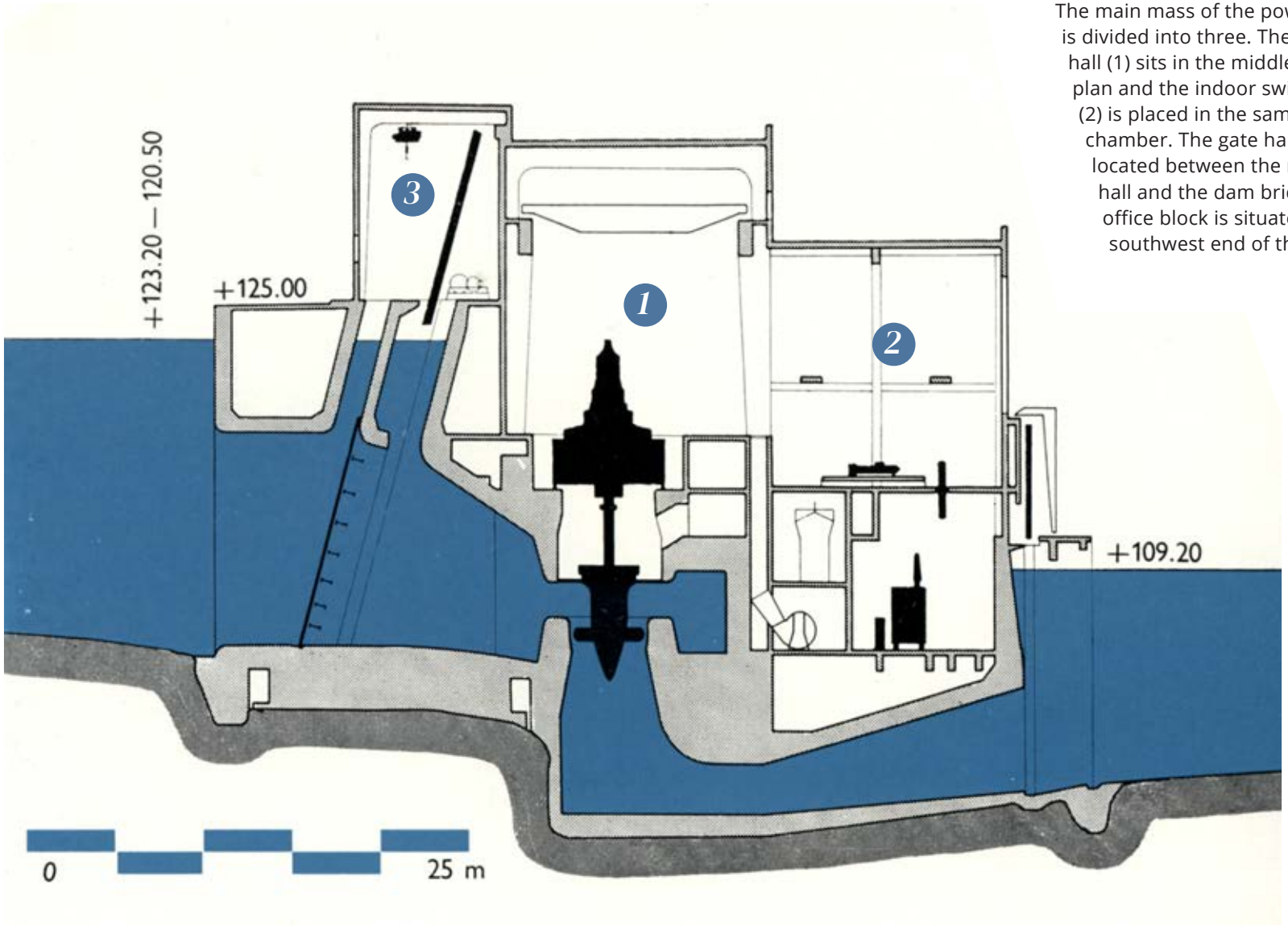
*The powerhouse of Jylhämä. Photo: Pekka Elomaa © Council of Oulu Region.*

*The regulating dam and powerhouse at Jylhämä. A view from the tailrace. Photo: Pekka Elomaa © Council of Oulu Region.*

*Powerhouse of Jylhämä seen from the southwest. Photo: Pekka Elomaa © Council of Oulu Region.*

At the southwest the end, the façade is stepped in three levels. The large maintenance door leading to the machine hall in the southwest was originally a steel-framed glass door, which made the whole machine hall transparent when natural light illuminated the interior. The main direction to approach the powerhouse is from the southwest, through the residential area. The surprisingly humane scale of the large power plant sits above a well-maintained parkland. Three rendered masses of the powerhouse overlap in a terraced fashion, rising towards the dam.

Natural light enters the building through the windows of the main entrance and illuminates the lobby and the stairwell. At ground level, the row of windows lightens the mass of the office section.




The main mass of the powerhouse is divided into three. The machine hall (1) sits in the middle of the plan and the indoor switchgear (2) is placed in the same open chamber. The gate hall (3) is located between the machine hall and the dam bridge. The office block is situated at the southwest end of the building.

*Ervi, a section of the Jylhämä powerhouse. © Fortum Power and Heat.*

*The stairwell of the office block. Lights by Paavo Tynell. Photo: Pekka Elomaa © Council of Oulu Region.*

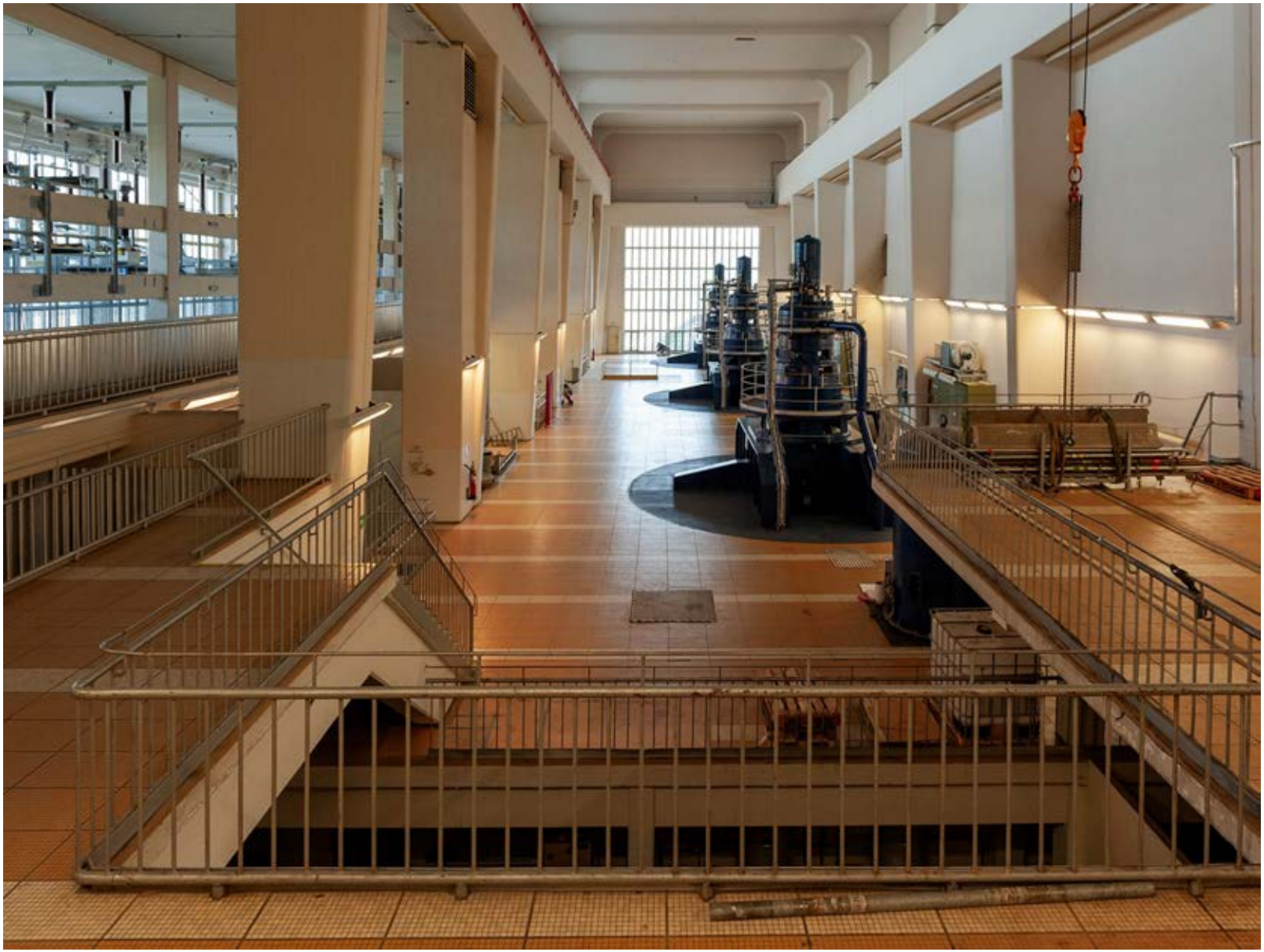
When entering the building, short steps lead to the control room corridor. A central element of the façade in the corridor wall is a large window. The whole exterior wall of the control room is glass, which blurs the boundary of interior and exterior and allows nature to flow into the room. The entrance lobby has a lift. The upper floor has offices that can be entered through a central corridor. On the other side, the high indoor switchgear is visible through a glass wall.

All these glass surfaces allow the light to stream into the machine hall, almost as if light were passing through a stained-glass window. In short, due to these feature, the Jylhämä machine hall is one of the finest of the power plants designed by Ervi.

The indoor switchgear is located on the side of the tailrace. This massive, almost cathedral-like space, was originally divided only by a colonnade. Later light partition walls were erected for safety reasons. Fortunately, these walls are rather translucent and do not affect the overall flow of the space. The decision to place the switchgear in the machine hall was common in French and North-American hydropower plants. Presumably, Jylhämä's decision is based on those examples.[1]

The flat terrain made it possible to divert the rails straight into the machine hall. Below the switchgear is a submersible compartment for electric devices.

*1 Myllykylä 1991, 80*

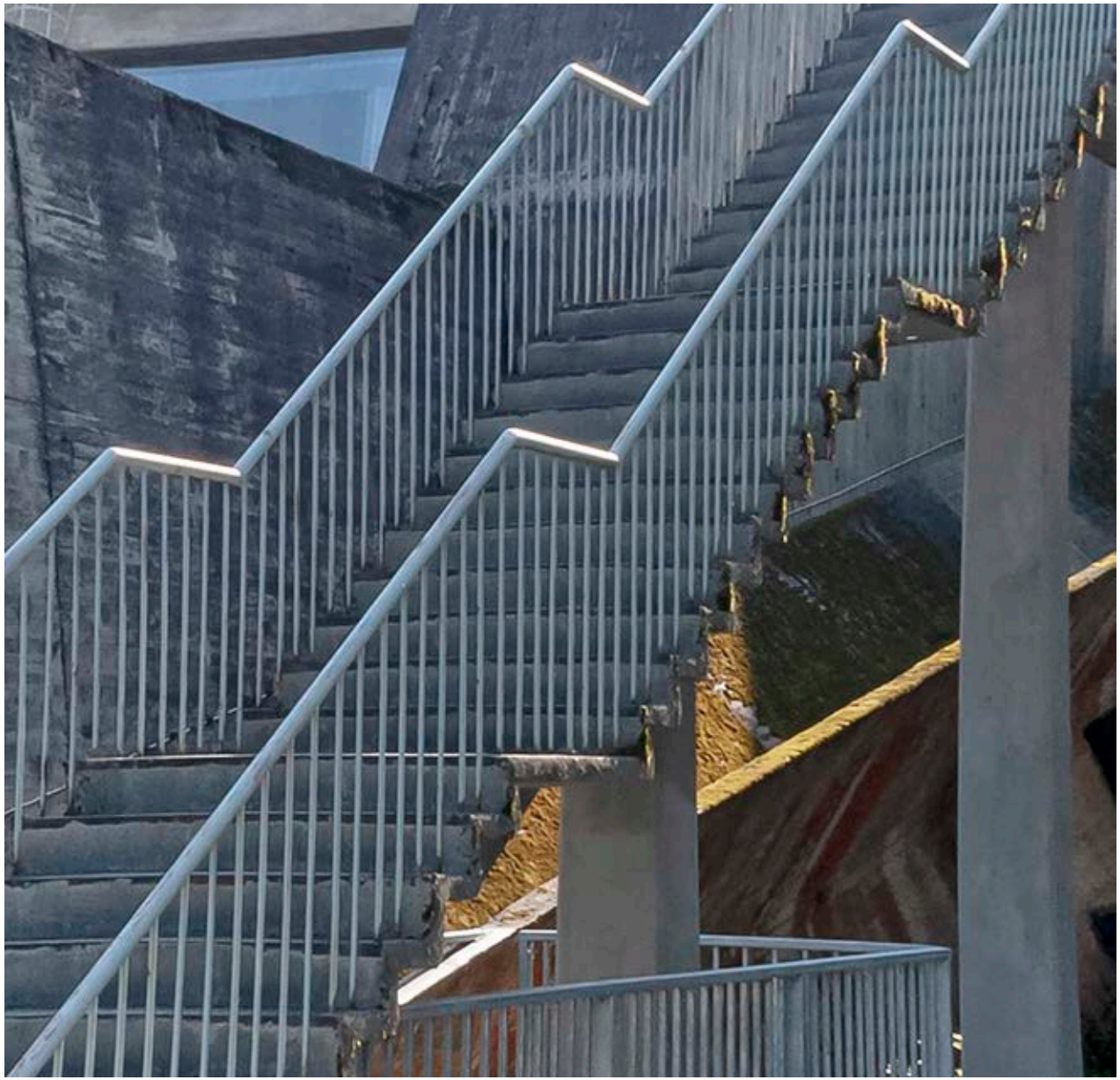


*The machine hall of Jylhämä. Photo: Pekka Elomaa © Council of Oulu Region.*

*The control room of Jylhämä. Photo: Pekka Elomaa © Council of Oulu Region.*

The offices and control rooms receive the same treatment of natural light as the machine hall. The windows, as tall as the room, open up towards the tailrace and bring water, air and greenery into the space while the soothing colour scheme compliments the overall atmosphere of the space.

Another architectural feature worth mentioning are the stairs outside the powerhouse. Here, Ervi uses the stairs next to the log chute as a dynamic interpreter of scale in a dizzying fashion. Placed on top of narrow concrete pillars, the stairs reach from the dam bridge to the lower bridge on the tailrace. Once again, these stairs can be considered as a statement on the possibilities of modern concrete construction.



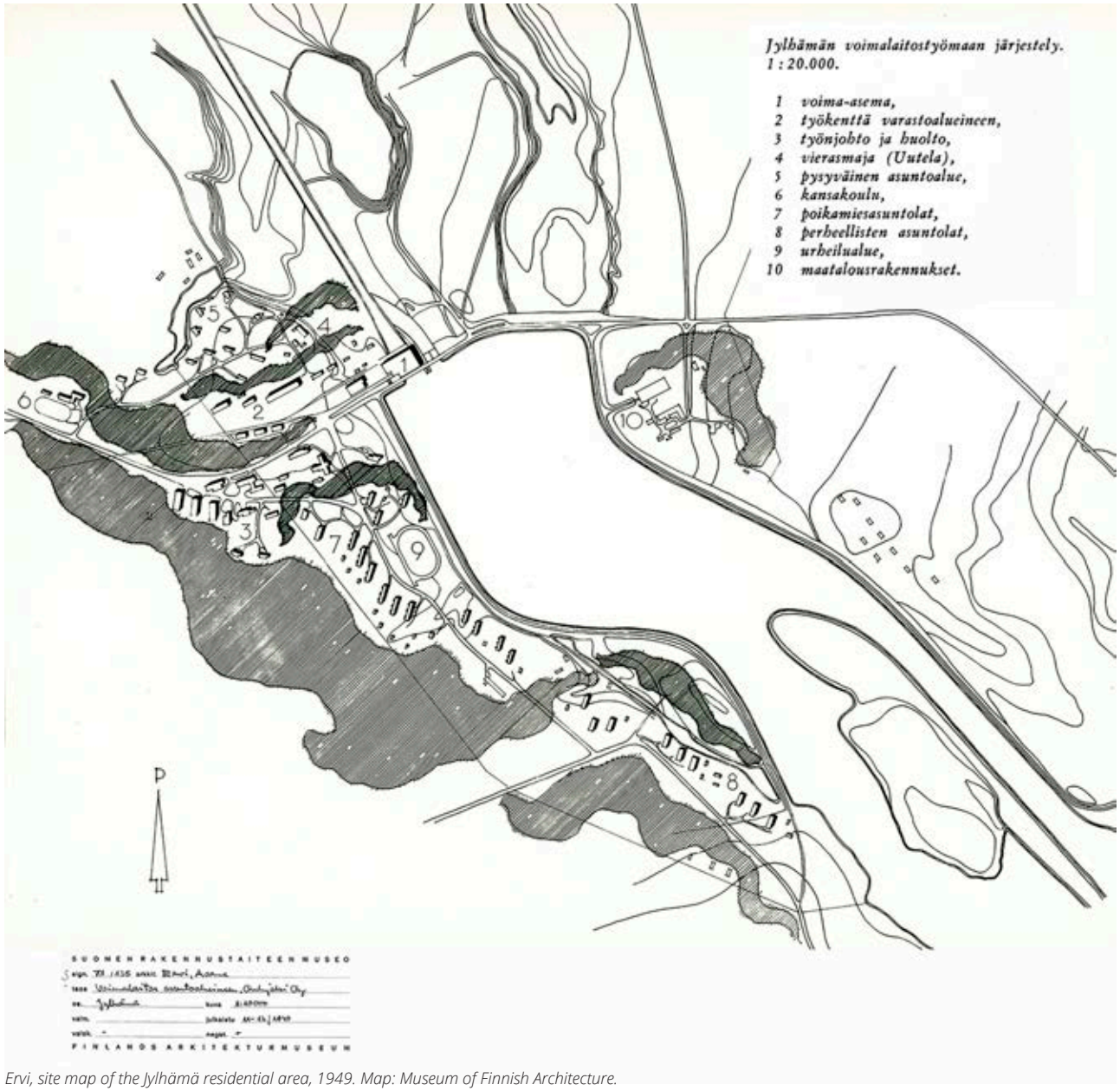
*The stairs outside the powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

## Residential area

The Jylhämä construction site also functioned as a hub for three power plants, Jylhämä, Nuojua and Utanen. As a consequence, Jylhämä had a large colony that when busiest, had over 2,000 workers. The area was built in the late 1940s. Jylhämä, at its largest, is visible on the map that shows the situation in 1949. The row of temporary housing stretches southeast along the river. This area was designed by the architect Aarne Ervi and his office.

After the power plants were constructed, most of the temporary housing at the riverside was demolished and the builders moved north to the construction sites on the River Emäjoki. What remained was what is now known as the residential area of Jylhämä – or the Jylhämä village. Today, the residential area consists of approximately 30 buildings. According to the site plan, to better incorporate the surrounding nature, the buildings are placed freely along two roads that circle the area. The scenery is lush and green, but through its well-planned landscaping, it is separate from the surrounding forest.

Jylhämä showcases many of Ervi's trademark architectural features such as his insightful use of materials, intriguing details and understanding of the connection between the building and nature. In an architectural sense, Ervi presents a softened approach to modernism with the use of vernacular, almost romantic features and materials such as wood, slate and plaster. The dwellings in Jylhämä are referred to as "type houses" and feature single-family detached houses and two-family semi-detached houses. The area also has several service buildings and warehouses. In the early 1960s, three row houses designed by Ervi were built in the southern part of the area.




*Ervi, site map of the Jylhämä residential area, 1949. Map: Museum of Finnish Architecture.*

In its prime, Jylhämä had two grocery stores, a bookstore, a post office, a school, a fire station/ a police station and even a movie theatre - a rare feature in the rural Finland of the 1950s. The area also has a guesthouse that was built next to the Uutela farm that dates back to the previous century. Places such as Jylhämä gave Oulujoki Power Company the chance to showcase its success and progress and important guests, such as President Kekkonen, would visit.

During the 1970s, the power plants became more and more automatic and could no longer provide work. Therefore communities, such as Jylhämä, slowly began to decline. Currently, all the services have been discontinued and some of the houses are also uninhabited. In the early 2000s, a large section of Jylhämä was sold to a private investor. Unfortunately, this has not contributed to the preservation of the buildings, and many have deteriorated.

Jylhämä residential area in 2022:

Six semi detached two-family houses (1)

Three detached single-family houses (2)

A guesthouse (3)

A service building (4)

A machine workshop (5)

Six warehouses/workshops (6)

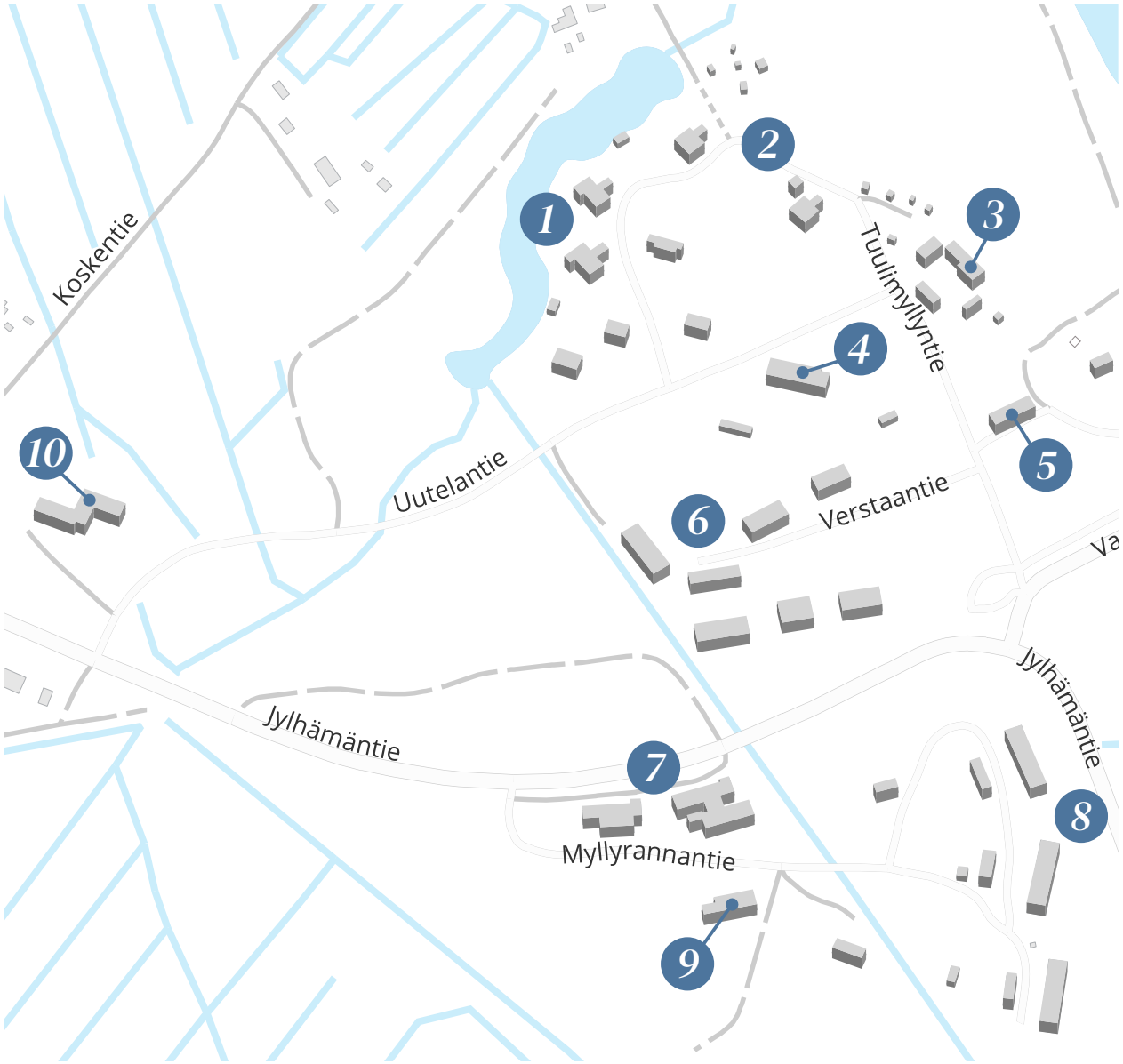
Two commercial buildings, a store and a car service and traffic office (7)

Three row houses (8)

A fire station/police station (9)

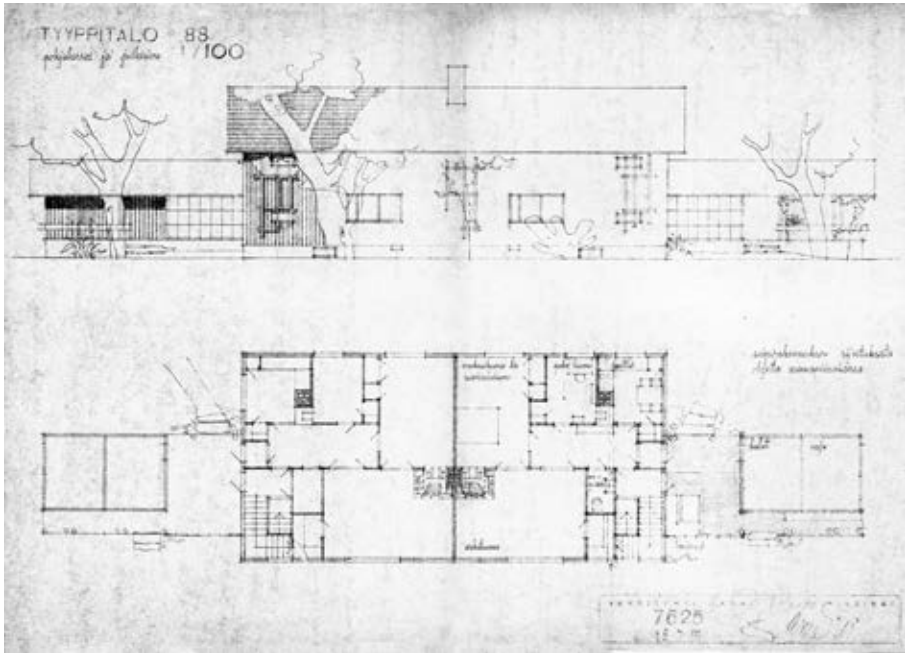
A clubhouse that functioned as a school, a movie theater and as a community hall (10)

The area also has several saunas, garages and also an outdoor museum.




*Jylhämä residential area. Map: Museum of Finnish Architecture. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

*House type 88 in Jylhämä. This wooden semi detached house has two apartments.*
*Photo: Pekka Elomaa © Council of Oulu Region.*




*Ervi, Jylhämä residential area, type house 88, northeast elevation and groud plan. © Fortum Power and Heat.*

Jylhämä has two different two-family type houses. This house type 88 by Ervi features two or three bedrooms (depending on the usage) per apartment on two floors. The house has an architectural language that is rather typical of the post-war era houses in Finland.

The house has a wooden balloon frame with a board and batten cladding and a tile roof. The house also has a concrete foundation with a basement. The appearance of the house has been slightly altered by the later addition of insulation to the exterior walls as well as to the foundation.

Other than that addition, the house is in its original condition, Ervi's original drawing depicts the elongated porches on each side of the building but the end result shows that the porches were made considerably smaller.

*The Jylhämä residential area. Photo: Pekka Elomaa © Council of Oulu Region.*

*Ervi's type house 90 in Jylhämä. The house has two apartments. Photo: Pekka Elomaa © Council of Oulu Region.*

The other two-family type house in Jylhämä by Ervi is type house number 90, which is slightly more adventurous in its architecture. The main mass and the elongated storage form a t-shape that also divides the yard in two, creating a private space in the front yard for both apartments.

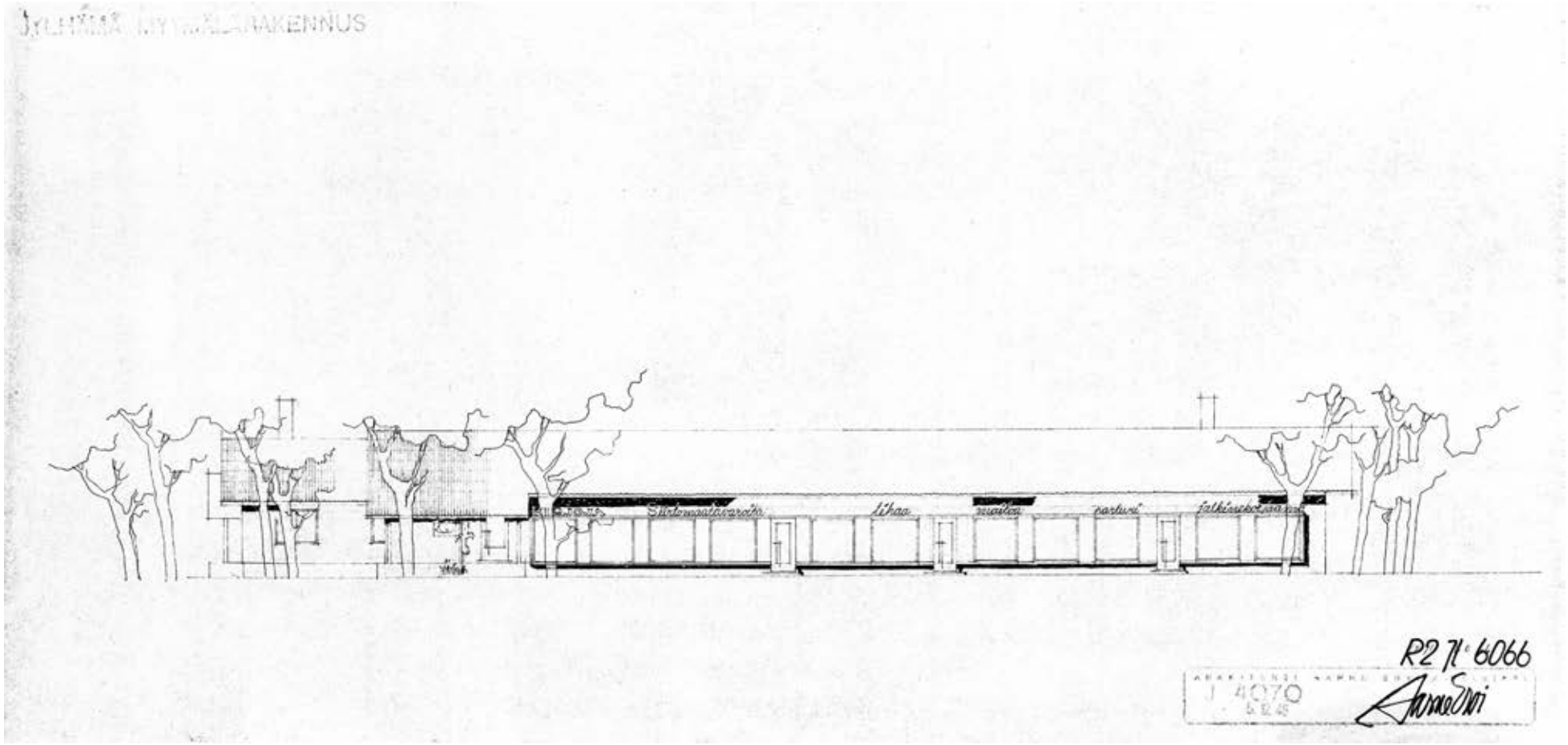
This two-three bedroom semi-detached house has a wooden balloon frame with a board and batten cladding and a tile roof.

Unfortunately, these houses have been uninhabited for long periods and are beginning to become dilapidated. Despite this, these houses are salvageable.


The car service and traffic office -building in Jylhämä had garages and service spaces for the cars of the company. It also had a gas station and rooms and offices for the company's drivers. The building is not in use anymore and has started to deteriorate.

*The car service and traffic office of Jylhämä. Photo: Pekka Eomaa © Council of Oulu Region.*

*The store building of Jylhämä in the summer of 2019. Photo: Pekka Elomaa © Council of Oulu Region.*



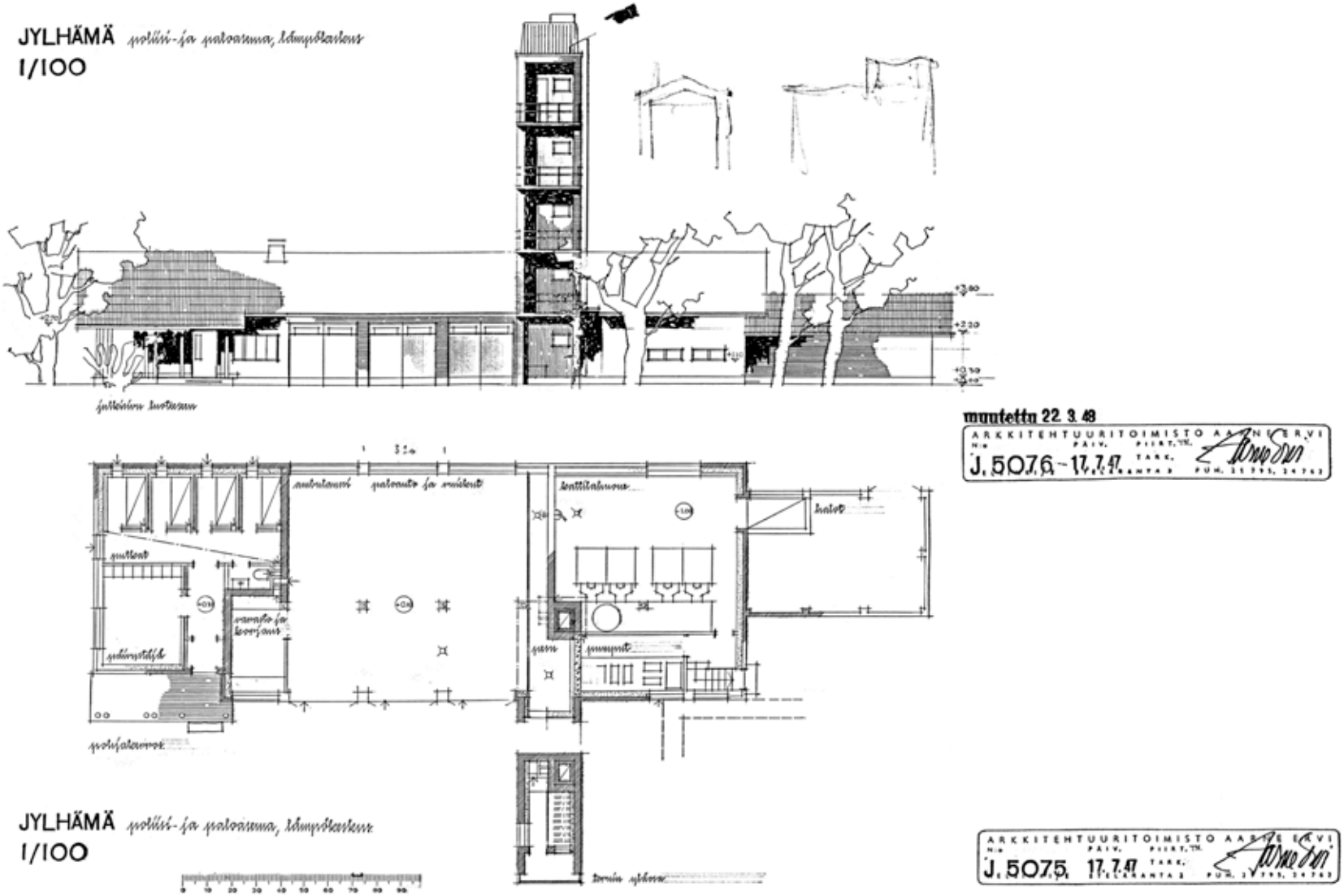

*Ervi, Jylhämä store building, north elevation. © Fortum Power and Heat.*

The store building of Jylhämä provided several commercial services for the residents. These included a grocery store, a bookstore, a barbershop as well as an apartment for the shopkeeper.

The horizontal mass and modernist architectural features of this wood-constructed building are typical of Ervi's work. The unique features are the large display windows and signs on the façade facing the road.

The store is also one of those buildings in Jylhämä that has been vacant for years and has begun to become dilapidated but is still salvageable.

*The Jylhämä fire station also worked as a police station. The chimney has been later extended. Photo: Pekka Elomaa © Council of Oulu Region.*




*Ervi, the Jylhämä fire station/police station.north elevation and ground plan. © Fortum Power and Heat.*

The Jylhämä clubhouse functioned as a school, a movie theatre and as a community hall.
The building has been unused for a long time and has begun to deteriorate but is salvageable.

*Photo: Pekka Elomaa © Council of Oulu Region.*

*Jylhämä has several wooden saunas built in the waterfront. Photo: Pekka Elomaa © Council of Oulu Region.*

# 5.1.4 Pälli

Pälli was the third power plant built by the Oulujoki Power Company on the River Oulujoki. It is located in the municipality of Muhos. The Pälli hydropower plant is built on a section of the River Oulujoki where the serene Paskonkoski turns into the effervescent rapids of Pälli, which are 300 metres long. Pälli showcased new architectural features and construction techniques and this was important for the development of the construction industry throughout the country.

Construction began early in 1950 when the work at Pyhäkoski was drawing to a close. Preliminary works had been carried out the previous year by building a highway, a railway track, and a temporary bridge across the river.

The machinery for the project was ordered from Finnish companies: turbines from Tampella and generators from Strömberg. The main construction centre was located 9 km away at Pyhäkoski, so the number of temporary housing at Pälli remained small.[1] In addition to the power plant, a small number of administrative and service buildings was constructed on site.

The cofferdam was constructed during the winter of 1951. This made it possible to start the excavation and rock blasting works. Concrete works also began in the same year. The most challenging job was digging the tailrace that was over 300 metres long. An average of 500 men worked on the site and 500,000 m2 of earth was excavated and removed. Work progressed rapidly because the most acute shortages were over and more machines were available. The workforce was also more experienced and they could apply the practices and teachings of past assignments[2].

The dams were completed in 1952 so that in November of the same year, the water could be impounded to its maximum level. The powerhouse was finished in 1953. The first set of machinery was connected to the power grid on 20 July 1953 as well as the second one at the end of that year. The third set of machinery was connected to the grid during the summer of 1954.[3]

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1949–1954
**Architectural design:** Aarne Ervi, architect
**Structural design:** Veikko Axelson, Osmo Korvenkontio, Veli Lehtonen, Juhani Kilpeläinen, Harri Sistonen, Ilkka Paaja
**Machinery:** Three Kaplan turbines with vertical axis
**Capacity:** 51 MW
**Head**: 14 m
**Flow**: 237 / 450 m3/s
**Powerhouse:** On-site cast concrete frame, precast concrete panels
**Special features:** Butterfly roof and insulated precast panels
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes), Docomomo site
**Zoning status**: Master plan

*1 Kuuskoski 1991, 3*

*2 Enbuske 2010, 317*
*3 Ibid 318*

*Pälli seen from the forebay. Photo: Pekka Elomaa © Council of Oulu Region.*

## Location

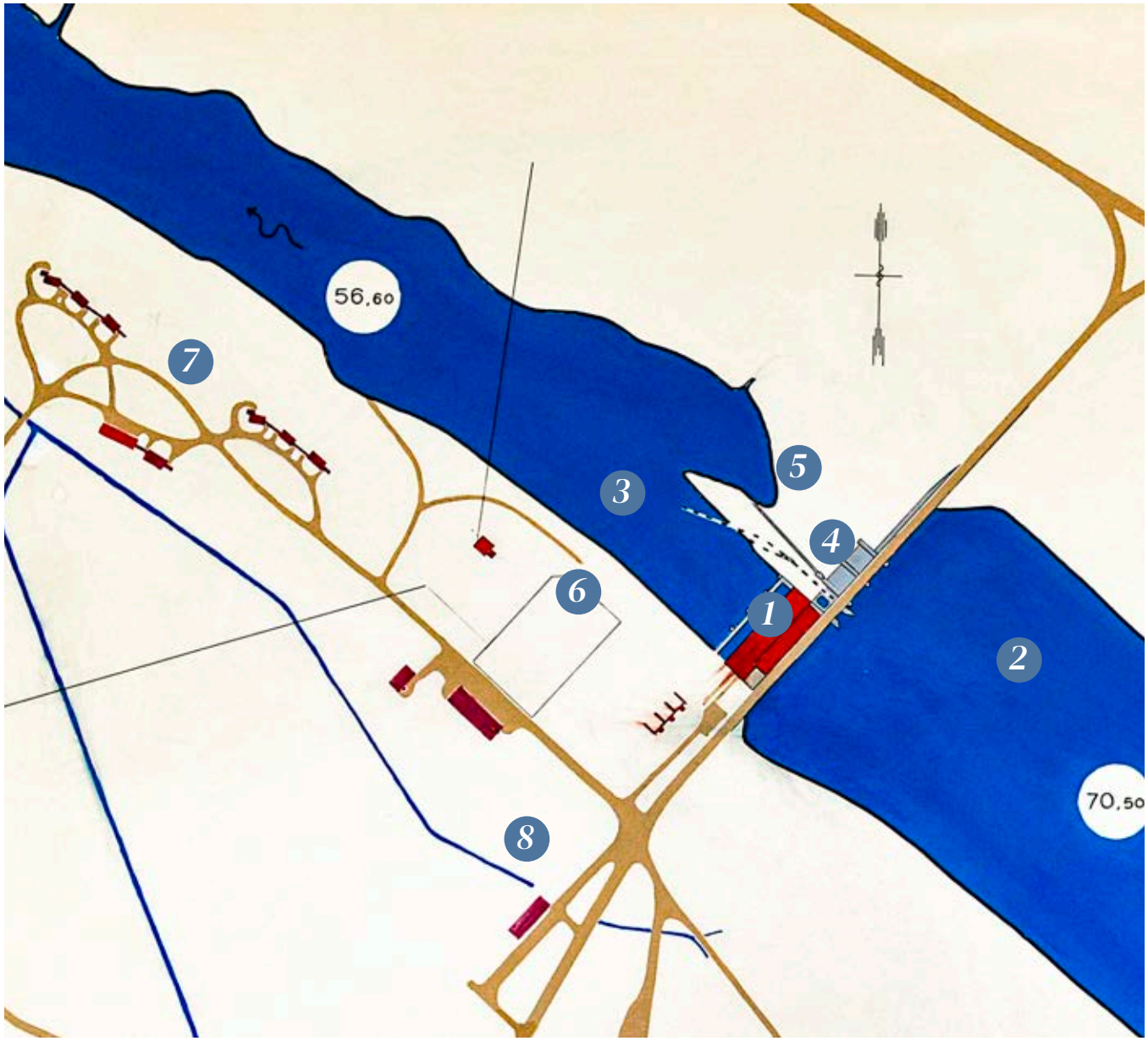

*Pälli is located along the River Oulujoki in Muhos municipality about 13 kilometres from the Muhos city centre and approximately 47 kilometres southeast of Oulu.*
*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement

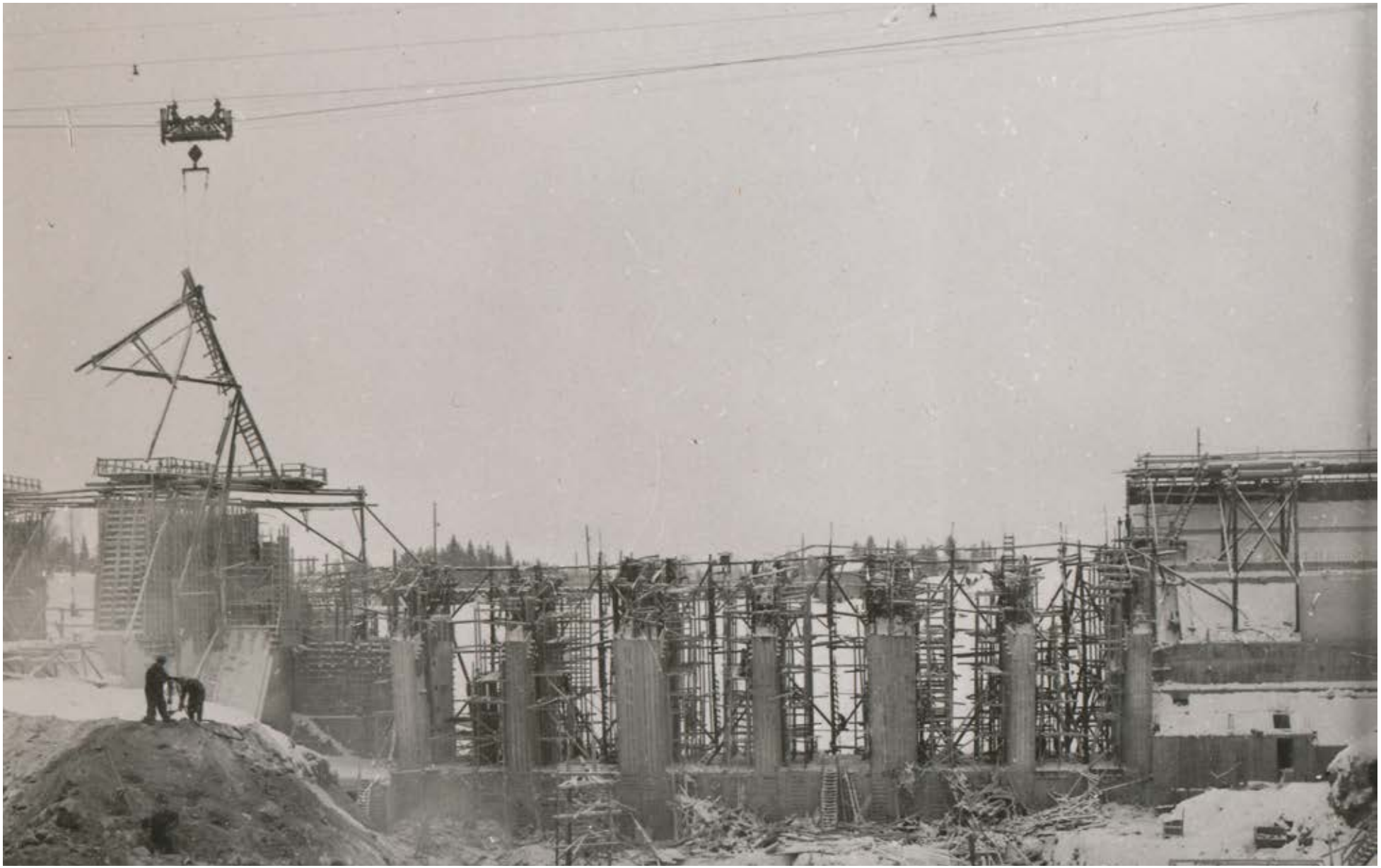
Powerhouse (1) of Pälli is built on the southern bank of the River Oulujoki. Water is diverted from the headrace (2) to the turbines through the intake gaps and released into the tailrace (3) that was excavated during the construction.

The regulating dam (4) is right next to the powerhouse. The dam has two spillway gaps with radial gates. Floodwater is released into the old riverbed (5) that is separated from the tailrace by a concrete wall. The switchyard (6) is located on the southern shore of the river.

The small residential area (7) is built approximately 250 metres northeast from the power plant. Most of the warehouses and offices have been demolished but a few still exist (8).




*Site map of Pälli. Map: Fortum Power and Heat.*



*Pälli powerhouse under construction. The draft tubes are being casted. Photo: Foto Roos © Fortum Power and Heat.*


*Pälli powerhouse during construction. Photo: Foto Roos © Fortum Power and Heat.*

*Pälli in the 1950s. The tailrace and the old river bed are separated by a concrete wall. Photo: Foto Roos c Fortum Power and Heat.*

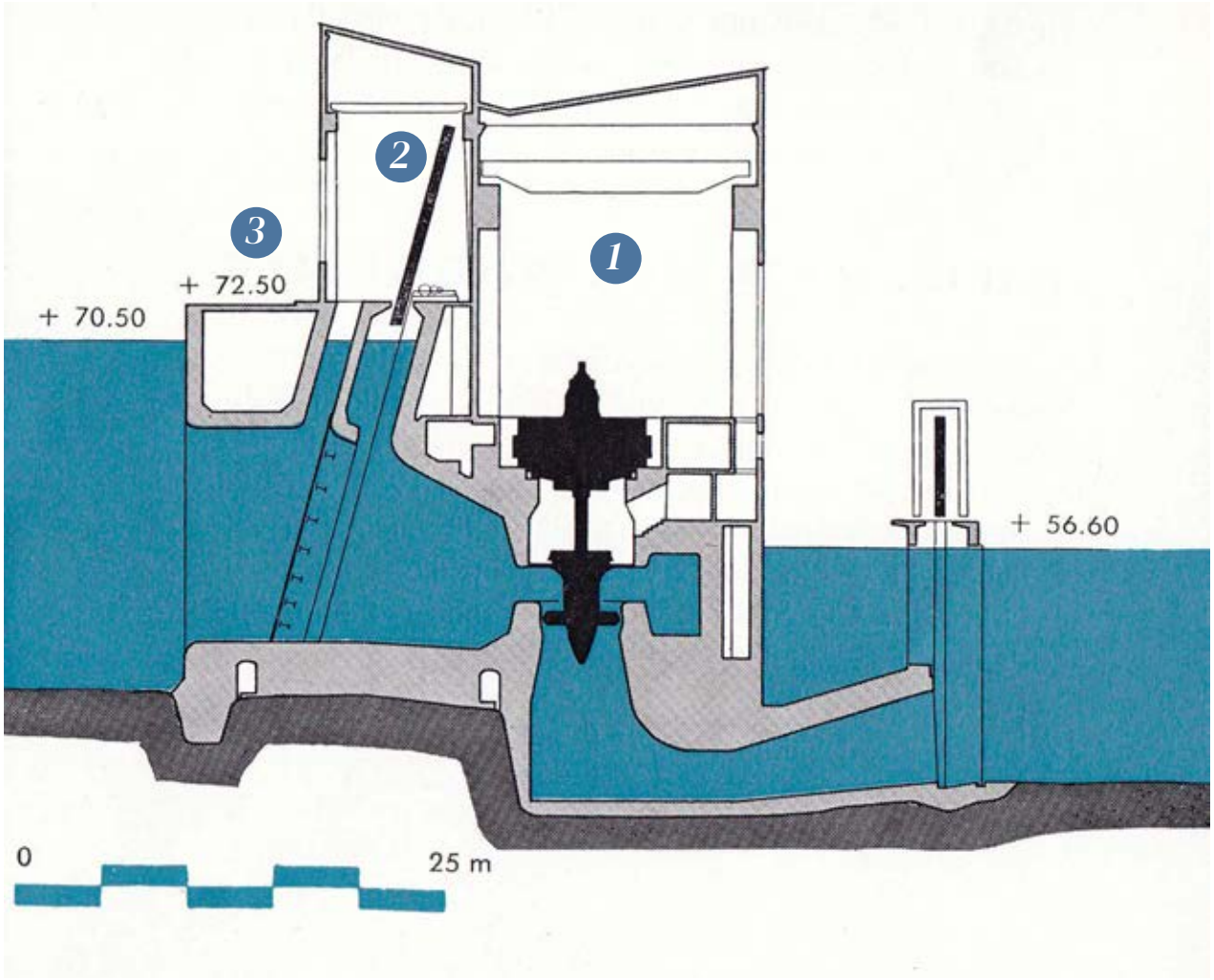
Pälli signified an evolution in Ervi's power plant design. After a certain static monumentality and the classicist undertones of Pyhäkoski and Jylhämä, in Pälli, Ervi took a step towards the principles, construction methods and aesthetic aspirations of modernism.

The most significant shift was that Ervi moved away from brick façades and began to use precast, insulated panels that were assembled on site. The distinctive feature in the overall appearance of Pälli's powerhouse is Modernism. This is evident in the disposition of the masses, the butterfly roof, the large window surfaces and the curtain-like façades.

The powerhouse was built on the southern riverbank behind the cofferdam and the tailrace was excavated in the river flowing downstream. Upstream, the riverbanks were elevated with embankments so that when the water was impounded in the reservoir, the total head of the power plant was 14 metres. The water that was discharged from the penstocks was directed into the new channel and the spillway gates opened up to the old riverbed. The two channels were separated by a concrete wall.

Today, forests cover any sign of the construction work and the river runs quietly through the facility. The riverbanks are shallow and the wide reservoir dominates the scenery of the headrace. When finished, Pälli had a capacity of 51 MW.

*Pälli powerhouse as seen from the south. Photo: Pekka Elomaa © Council of Oulu Region.*




The Pälli power house has a simple, streamlined overall mass. The largest block is the machine (1) hall. The gate hall (2) is placed right next to dam bridge (3). The signature features are the butterfly roof and the facades formed out of prefabricated concrete panels.

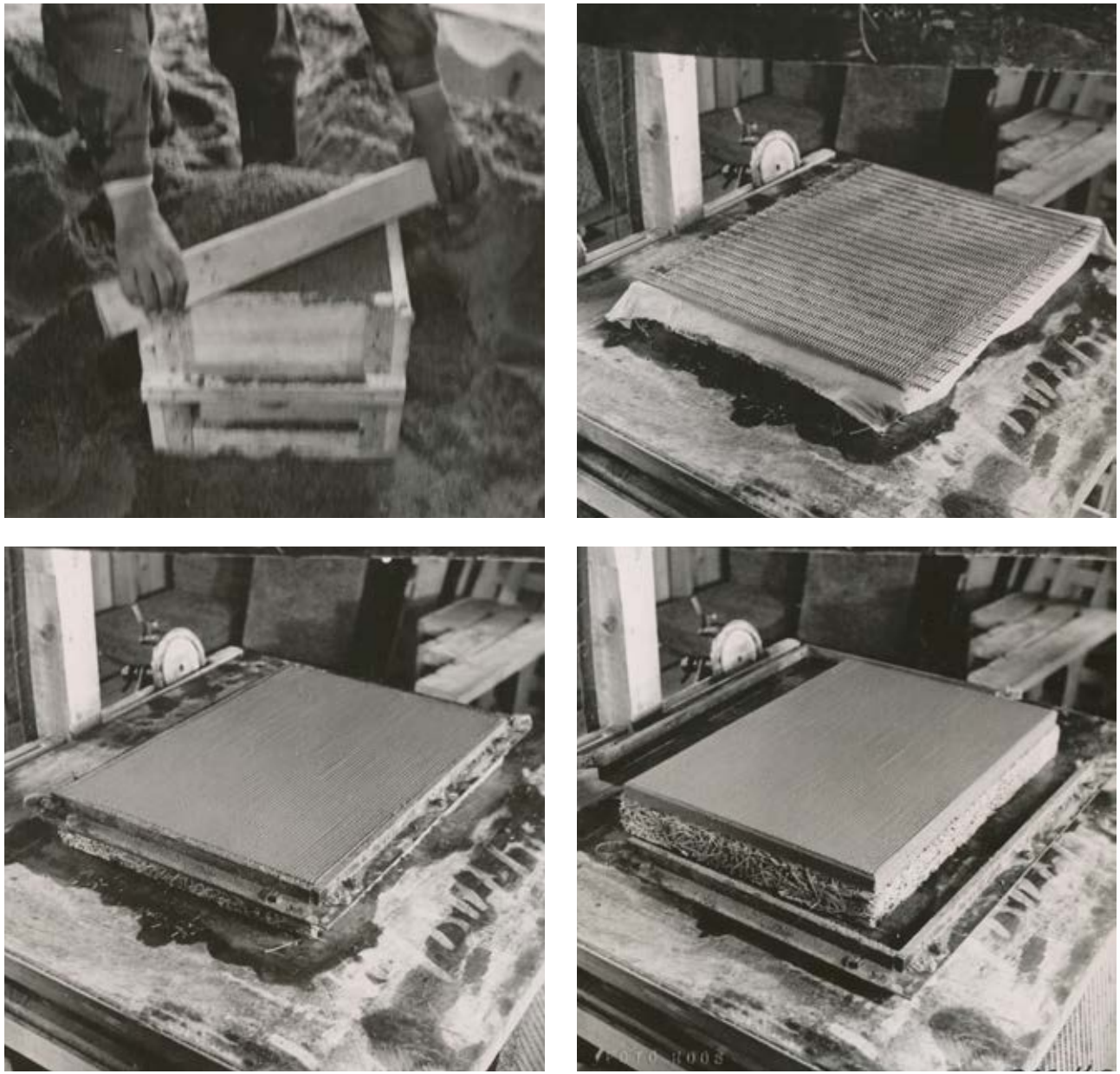
*Photo: © Fortum Power and Heat.*

The powerhouse of Pälli was built with an in-situ concrete frame and cladded with precast, insulated concrete panels. The panels were manufactured on site layer-by-layer and attached to the frame.

It is important to note that the whole Oulujoki project was a significant testing ground for Finnish concrete construction. The concrete laboratory in Pyhäkoski produced results that benefited the entire country. Aarne Ervi's interest was especially focussed on precast panels as a means of standardisation.

At the same time as Pälli, Ervi's Porthania building in Helsinki was being built. In Finnish architectural history, Porthania is usually given the title of being the first notable building constructed of precast panels in the country. However, as Porthania was completed in 1957, this title should be given to the powerhouse of Pälli that was finished three years earlier.

With his use of precast panels in these power plants, and in his later projects, Ervi quickly became the frontrunner in the use of prefabricated concrete in Finland.



*Fabrication of Pälli's panels. © Fortum Power and Heat.*

*The machine hall of the Pälli powerhouse. Photo: Pekka Elomaa © Council of Oulu Region*

*Stairs in the Pälli powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

In Pälli, Ervi showcases some of his signature design traits in a confident manner. The massive fare-faced concrete casts are of the highest quality. The monoliths are separated by a movement joint. The column/precast panel construction made the large window surfaces possible. This, in addition to the glass doors, allowed for the natural light to flow through the volume from several different directions.

Unfortunately, the original glass door leading to the service space has been replaced by a steel door and the window surfaces of the main entrance have been partly covered. This greatly reduces the translucent effect of the original design.

Stair design was another feature that Ervi used to underline the achievements of concrete construction. In Pälli, Ervi's stairs are light, elegant and designed such that the form itself carries the load and no additional beams are needed.

*Structures of the log transport system still exist in Pälli. Photo: Pekka Elomaa © Council of Oulu Region.*

## Residential area

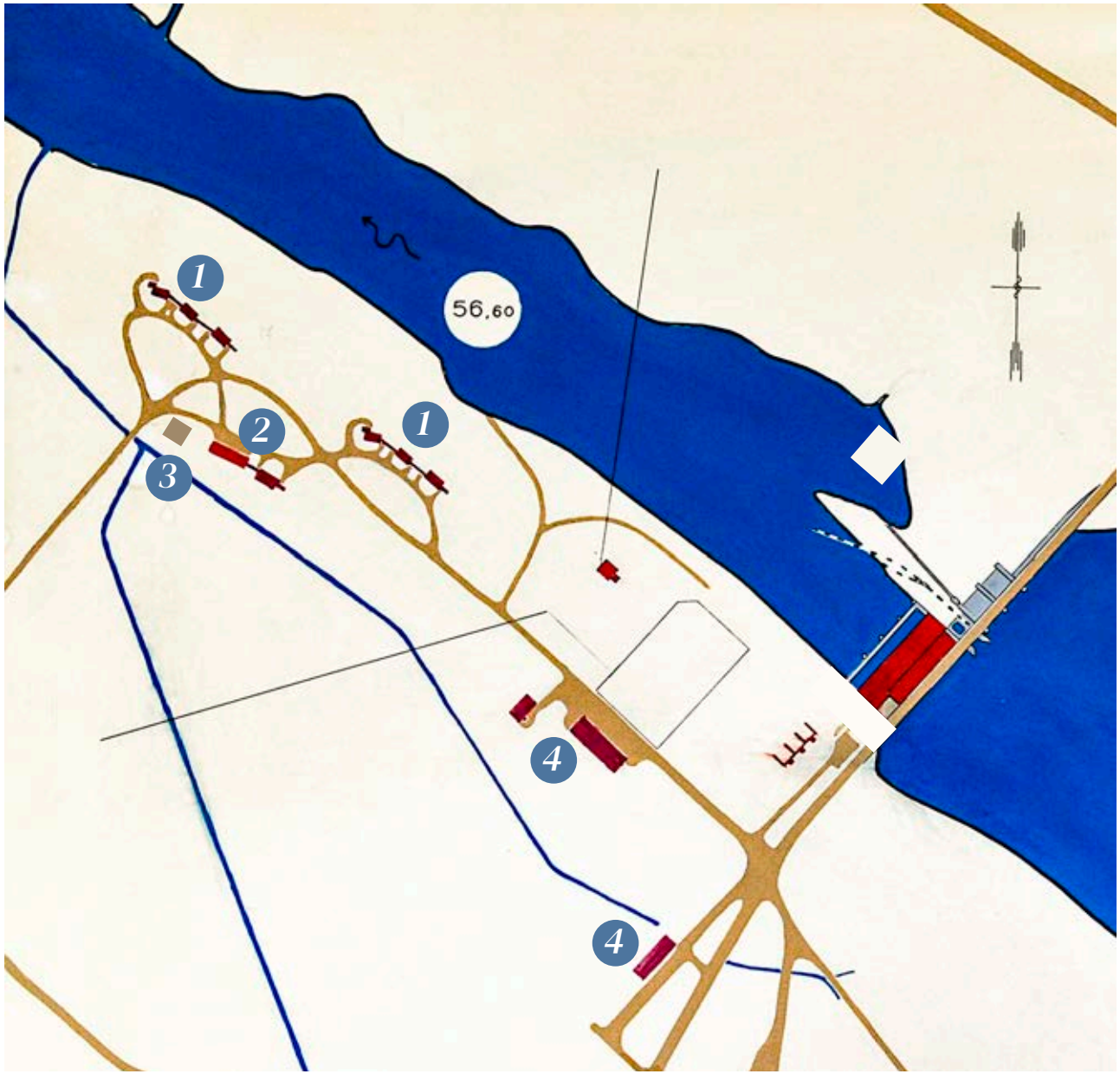
Pälli has a small residential area that is located approximately 250 metres northeast from the power plant along Voimatie road. This area was built at the end of the 1940s and the beginning of the 1950s.

The residential area consists of:
Two semi-detached linked houses (1)
Service building (2)
Garage (3)

There is also a warehouse and an office building (4) in the area. These buildings were part of the technical infrastructure of the power plant as well as the company's human resources. These buildings are now abandoned. Other warehouses have been demolished.

The area is composed around Voimantie road, which criss-crosses the area. Originally the area had a park-like setting with pools, a playground and a tennis court and the landscape was also more open and spacious. Today, the scenery is rather overgrown and the river is not visible from the houses. The tennis court is also no longer in use and the pools are dry. Even so, the area currently retains that park-like serenity that is highly distinctive of Ervi's residential areas on the River Oulujoki. An additional brick garage was built in the area in the 2000s.

The linked houses were built with a balloon frame, board cladding and tile roofs. Each linked house has six apartments. The service building has a frame constructed out of lightweight concrete blocks and a brick façade.




*The residential area of Pälli. Map: Fortum Power and Heat. Modifications: Samuli Paitsola*

*Pälli residential area. Linked houses under construction in the late 1940s. Photo: Foto Roos © Fortum Power and Heat.*

In Pälli, Ervi took three, two-family semi-detached houses and linked them together with a connecting element that also functioned as an outdoor storage and porch.

Here Ervi managed to create a unique housing type by creating a rather typical design with a simple balloon frame construction. The linked house type found in Pälli does not exist anywhere else in Ervi's residential areas.

The area is currently partially inhabited and the buildings are in reasonable condition.

*The linked houses in the Pälli residential area. Photo: Pekka Elomaa © Council of Oulu Region.*

*The Pälli residential area in the 1950s. Photo: Foto Roos © Fortum Power and Heat.*

*The porch/outdoor storage -hybrid functions as a connecting element between the houses. Photo: Pekka Elomaa © Council of Oulu Region.*

*The service building at Pälli. Photo: Pekka Elomaa © Council of Oulu Region.*

Pälli's service building was constructed with a lightweight concrete block frame and brick façades. The service building has two garages, a sauna, a laundry room, a bakery and a boiler room. The tile roof is a standard in all of Pälli's houses.

The service building in linked with a semi-detached house, similar to other houses of the area. The house has a communal kitchen and one apartment.

# 5.1.5 Nuojua

Nuojua was the fifth hydropower plant built on the river and the fourth built by the Oulujoki Power Company. The facility was built between 1946 and 1955 on the rapids of Niskakoski located in the municipality of Vaala. Aarne Ervi was responsible for the architecture while the structural design was created by Veikko Axelson, Osmo Korvenkontio, Veli Lehtonen, Juhani Kilpeläinen, Harri Sistonen and Ilkka Paaja.

Niskakoski was one of the largest rapids on the River Oulujoki. It was located near Lake Oulujärvi and was divided into the four smaller rapids of Oterma, Pyterä, Kovera and Nuojua. The construction site was propitious in Nuojua. The riverbanks were steep and the head of the rapids was significant at 22 metres.

After the geographical survey, it was decided that the powerhouse was going to be situated on the north bank of the river and the residential area was to be located downstream from the plant. The construction of Nuojua began at the end of 1946. As preparatory work, roads, a railroad and a temporary bridge across the rapids were built. Three sets of machinery was ordered from two Finnish companies, the turbines from Tampella and the generators from Strömberg.[1]

After the temporary dam was built, construction for the actual power plant began. Builders could utilise the Jylhämä concrete mixing plant and all the larger casts were made in1951. During that year, the spillways for the regulating dam and the –powerhouse's intake structures were finished on the north bank of the river. A concrete-framed girder crane was also constructed on the north ban to enable heavy machinery to be hoisted into the powerhouse and to the switchyard.

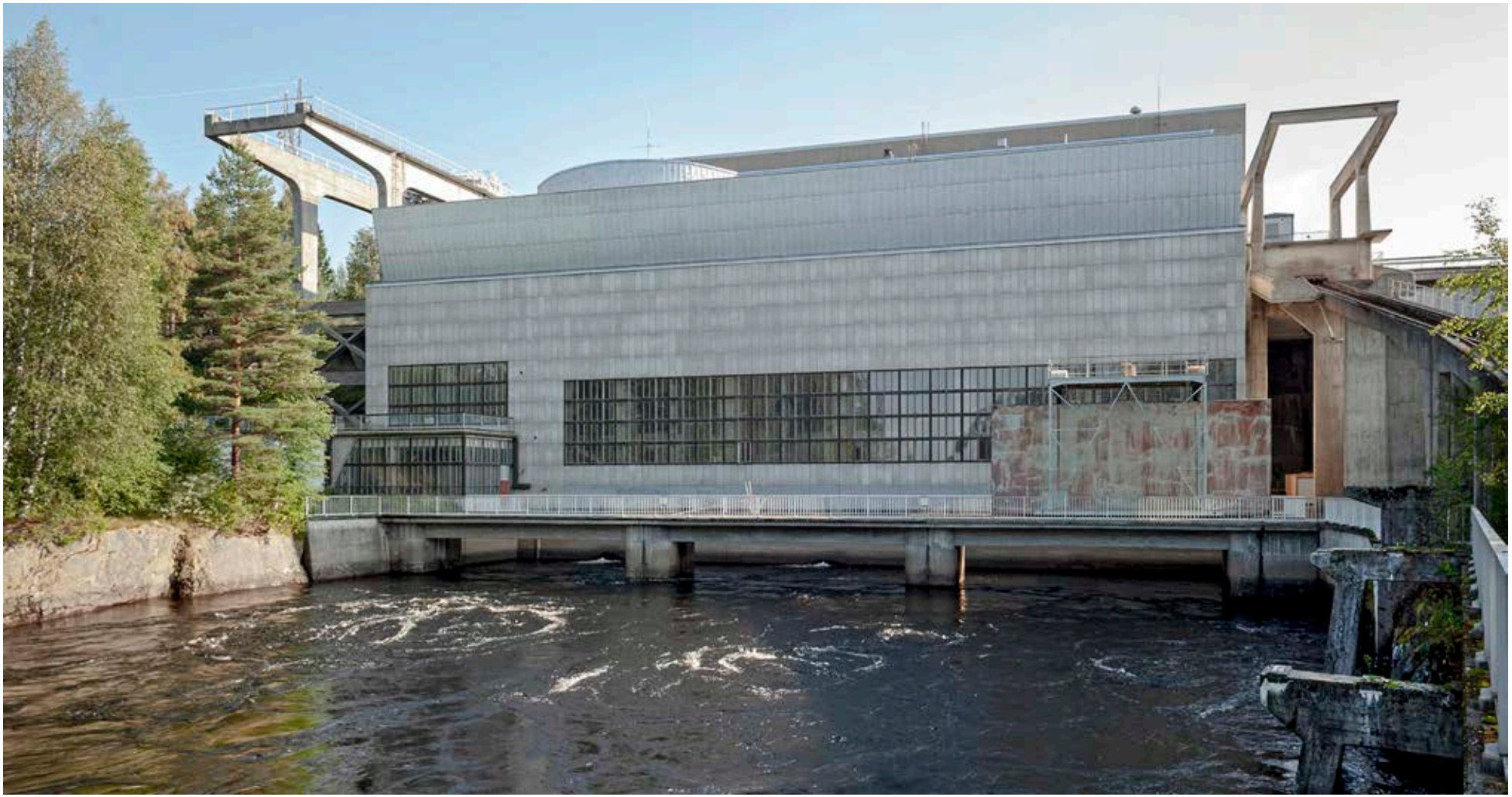
The powerhouse was built with an in-situ concrete frame and the façades were cladded with precast panels. The earth dam, 25 metres high, was built during the summer seasons of 1952 and 1953 and was finished in October of 1953. The three sets of machinery were connected to the power grid on 25 July 1954, 14 October 1954 and 16 January 1955. Once Nuojua was completed, the electricity production of the Oulujoki Power Company reached 1 billion kilowatt hours for the first time.[1] Today, Nuojua is the second-largest power plant on the River Oulujoki.

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1946–1955
**Architectural design:** Aarne Ervi, architect
**Structural design:** Veikko Axelson, Osmo Korvenkontio, Veli Lehtonen, Juhani Kilpeläinen, Harri Sistonen, Ilkka Paaja
**Machinery:** Three Kaplan turbines with vertical axis
**Capacity:** 85 MW
**Head**: 22 m
**Flow**: 450 $m^3/s$
**Powerhouse:** On-site casted concrete frame, cladded with precast concrete panels and sheet metal.
**Dams:** Concrete regulating dam build right next to the powerhouse. Two spillway openings with radial gates
**Special features:** Children and young people's home operates in the residential area
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes), Docomomo site
**Zoning status**: District plan

*1 Kuuskoski 1991, 39*

*1 Ibid 40*



*Nuojua hydropower plant. Photo: Pekka Elomaa © Council of Oulu Region*

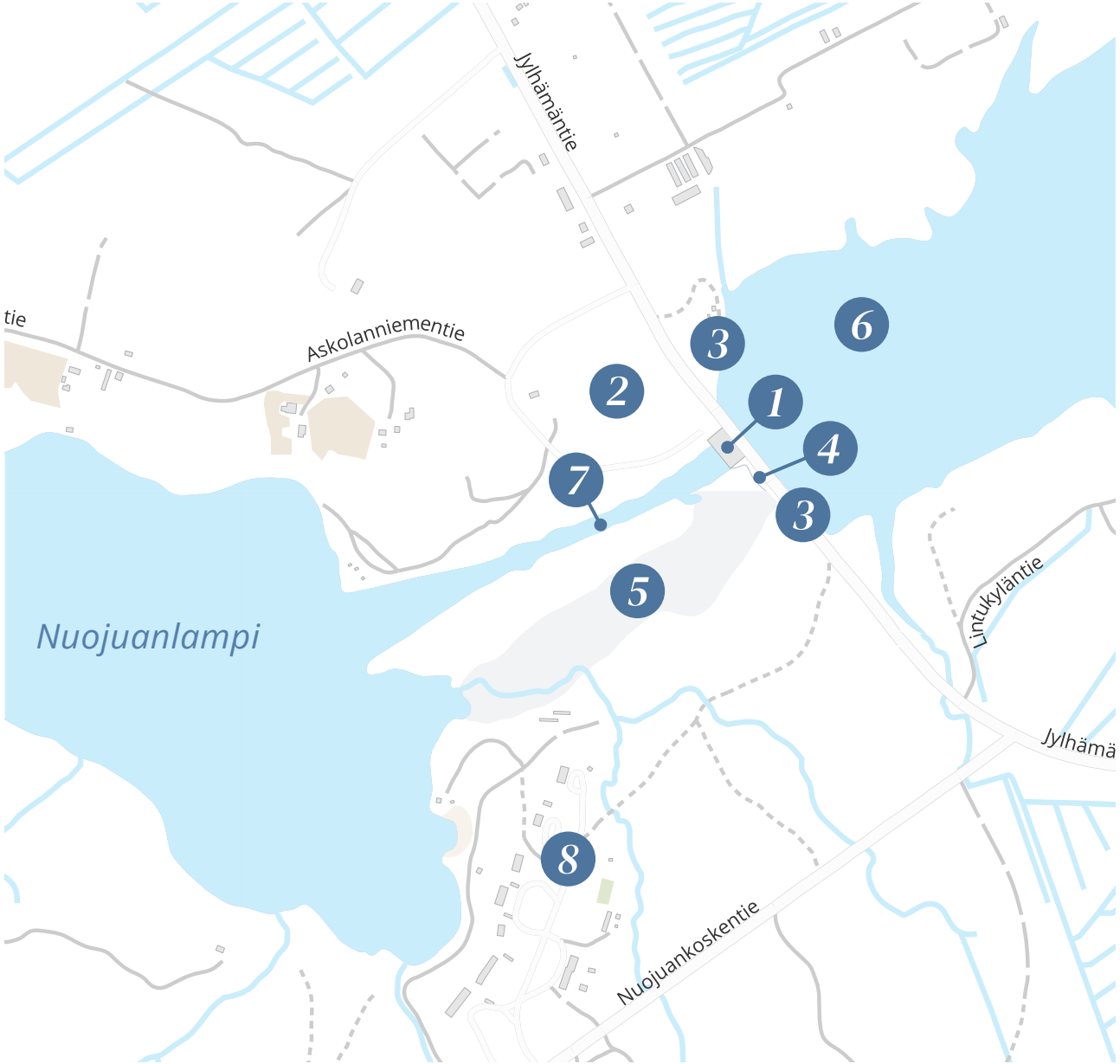
## Location


*Nuojua is located along the River Oulujoki in Vaala municipality about 7 kilometers from the downtown of Vaala and about 84 kilometers southeast from Oulu.*
*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement

The powerhouse (1) was built on the north bank of the river. The switchyard (2) is located right next to it. Embankments (3) were built on both sides of the powerhouse. Girder crane can be found on the north side of the building and another girder crane for lifting logs on the south side of the powerhouse. The old log-chute has been demolished.

The regulating dam (4), located on the south side of the powerhouse, has two spillways equipped with radial gates. The floodwater is released into the old riverbed (5) that is located south side of the tailrace. Headwater is derived into the turbines from the forebay (6) through the control gates. Tailwater discharges from the draft tubes to the tailrace (7) that has been mined into the bedrock. The residential area (8) is located about half a kilometer southwest from the power plant.




*Site map of Nuojua. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

*Nuojua during construction. Water is flowing through the spillway. Photo: Foto Roos © Fortum Power and Heat.*

## Architecture

Nuojua produces one-fifth of the total electricity produced by the River Oulujoki. The power plant head is 22 metres and it is the second-largest power on the river. The foundation for the powerhouse was mined from the bedrock of the north bank. The length of the tailrace is approximately half a kilometre and the excavated land masses were used to construct the embankments.

The foundations for the powerhouse, the canals, the frame of the building, the dams and the frame for the girder crane on the northwest end were built out of concrete and cast on site. A machinery for lifting the turbines, the generators and transformers from the train car to the powerhouse and to the switchyard was also constructed. The log chute was placed between the powerhouse and the spillway gates. Later, when logs were driven in rafts, a whole machinery was constructed to transport the logs over the dam and the chute was demolished. The supporting structures for the log chute remain intact and are visible on the tailrace.

When necessary, the spillway gates release the impounded water into the old riverbed that is located on the south side of the tailrace. The surrounding rural landscape consists of predominantly coniferous forest and occasional farms, but the power plant does not stand out disturbingly due to its subtle presence and composition.

*The Nuojua powerhouse as seen from the southeast. The gate hall is the tallest block next to the dam bridge. The machine hall is the largest block on the lower left. Photo: Pekka Elomaa © Council of Oulu Region.*

The frame of the machine hall is formed by nine sturdy concrete columns which support the two beams near the ceiling. The girder crane runs on top of these beams. These nine columns also have cantilevers that support the façade beams that run freely pass the columns. The precast panels are then attached to these beams. This means that the frame does not affect the disposition of the façade. This also made the large window surfaces possible. The fair-faced concrete cast are of a high standard and after all these decades of strain, remain in pristine condition.

The powerhouse opens up to its surroundings through large windows panes on both of the main façades. Four-framed window elements are hung on the beams between the modular lines. On the façade, the concrete panels and windows are attached to the same level.

The machine hall opens up through the large windows towards the tailrace. The view is best appreciated from the lower levels. Natural light also enters the building from below, infusing the space and creating its own ambiance. The dark-red concrete walls provide the originally silver-coloured generators with a decorous background, once again emphasising the achievements of technology. Unfortunately, these colours have not been preserved and the current dark-blue generators blend indistinctly into the dark background.

*The machine hall of the Nuojua powerhouse. Photo: Pekka Elomaa © Council of Oulu Region*

Due to the dimension of the regulating dam, the functions were organised similarly to those of Pyhäkoski.This meant that the transmission gear (1) was placed between the gate hall (2) and the machine hall (3). As the terrain is steep, the transmission gear has a different elevation than the machine hall and a separate railway track had to be built for it.


*The power house of Nuojua seen from the southeast. Photo: Pekka Elomaa © Council of Oulu Region.*

These power plants served as a testing ground for new building techniques and particularly for concrete construction. This is clearly visible in Nuojua because the insulated façade panels that Ervi used in Pälli had now evolved into a sandwich panel. The panels were produced on site and attached to the concrete frame using steel rods. The joint sealants have been renovated over the years. Despite the weather strain and the lack of eaves, the façades are in reasonably good condition. The wooden frames of the window elements are also original.

*The precast concrete panels and windows of the Nuojua powerhouse. Photo: Pekka Elomaa © Council of Oulu Region*

The main entrance hall is also cloaked in metal sheeting, but the large windows open up the space.

The view to the upper reaches dominates the entrance hall. This is where the receptionist would meet the incoming customer during the 1950s, 1960s and 1970s. The staircase then directs the customers to the lower floor to the lobby. The upper floors are reserved for offices.

This section is the main “public transport hub” of the building and this is where different functions interact and all the different parts of the building can be accessed through this space. The floors are connected by elegant, concrete, curving stairs with wooden handrails. These stairs can be seen as a reference to Ervi’s Porthania.

The most dominant material is the painted concrete with quartz vinyl tile on the floors. The wooden handrails on the stairs and wooden Artek furniture soften the overall appearance together with nature entering the space through the large, wooden-framed windows.

A large aerial photo of the rapids is on the wall of the entrance hall, serving as a reminder of the landscape before the power plant was built. A map of the water system is painted on the wall of the waiting room. Its function is to highlight the totality as well as the scale of this mega system.

*The entrance hall of the Nuojua powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

*The waiting lobby of the Nuojua powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

The actual electricity production happens behind the concrete façades. The section with metal sheeting has a more of a free form as here Ervi diverged from his earlier, strict rectangular shapes. The vertical ribbons in the sheeting and the metal glistening in the sun give this mass a dynamic feel as it rises between two concrete blocks. The control room is located behind a curved wall on top. Steel grids, built in the machine workshop of Jylhämä, support the roof and the metal sheeting.

The gate hall is filled with natural light from the large window plane that opens toward the forebay. Its roof is supported by fair-faced concrete columns and a beam cast on site. The façade and its large window surface is attached to the precast beams.

The concrete panels, the window elements and the metal sheeting all have the same distribution. The façade and its lines wrap the building in a rectangular ”net”. Behind the façade, a lattice is formed by the modular lines. This lattice defines the dimensions and structural integrity of the building.

Overall, the architectural expression of the powerhouse communicates its primary function, industrial production, successfully. Furthermore, the articulation of the masses, the use of sheet metal and glass on the façades, gives the building a sense of levity and flow. This separates Nuojua from the monumentality and static presence of Ervi’s first two power plants, Pyhäkoski and Jylhämä.

The dynamic architectural language of Nuojua powerhouse represents the ”second phase” in the evolution of Ervi’s hydropower design.[1]

1 Huhmo 2017, 64

*The powerhouse of Nuojua seen from the west. Photo: Pekka Elomaa © Council of Oulu Region*

*The powerhouse of Nuojua seen from the tailrace. Photo: Pekka Elomaa © Council of Oulu Region*

## Residential area

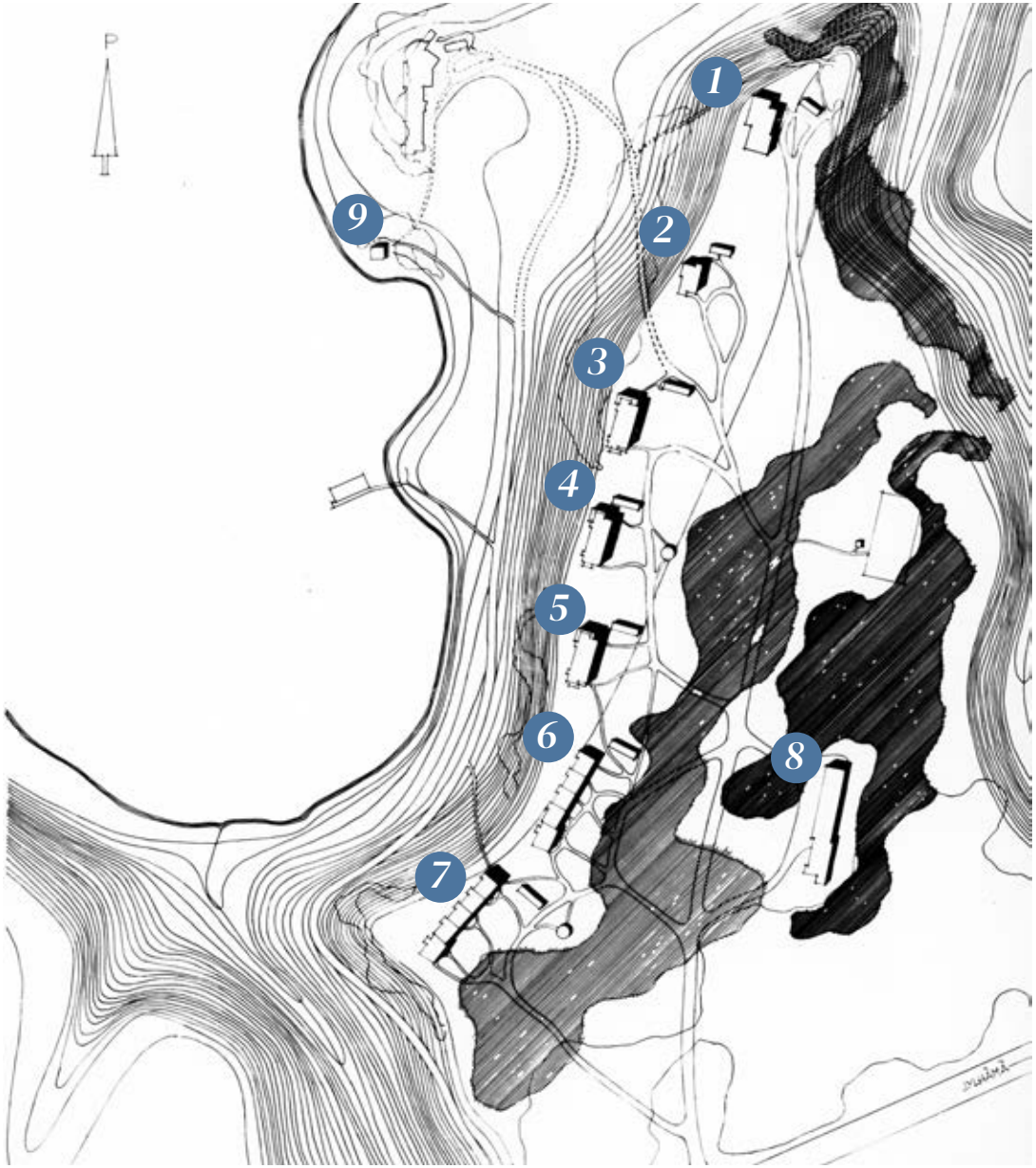
Nuojua has a medium-sized residential area that is located along Nuojuankoskentie road about half a kilometre southwest from the power plant. This area was built at the end of the 1940s and early 1950s. Situated on top of a wooded ridge, this area has a beautiful prospect to the river.

The residential area consist of:
Two detached single-family houses (1&2)
Three semi-detached two-family houses (3, 4 & 5)
Two row houses (6 & 7)
Service buildings (8)

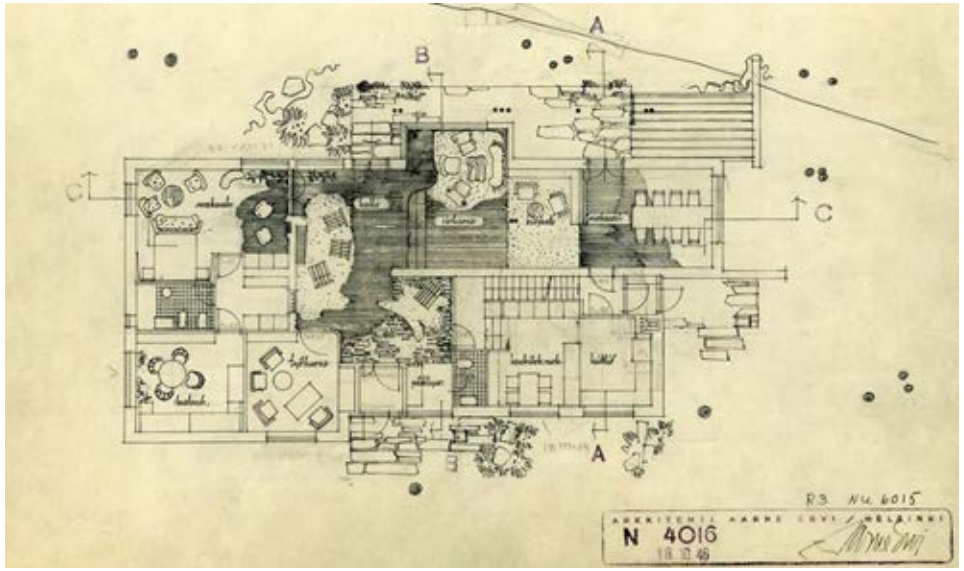
There is also a sauna (9) built on the shore of the bay, south from the area. The area also has an old chicken coop that currently functions as a horse stable. The old outdoor storage spaces have also been converted into garages. Each house has its own garage. Other important features are the two ice cellars located in front of buildings 7 and 4. These were an important part of the food supply for the area.

The buildings are composed in a hierarchical line formation from southwest to northeast such that the row houses and the service building are first in line when entering the area. The single-family houses, referred to as the engineer houses, are at the back of the road and thus at the top of the hierarchical order. Between these are the three semi-detached houses.

The service building is located on the north side of the area. This building has a sauna, a laundry room, a garage, and an apartment for the janitor. The building also has an old boiler room. The old tennis court is situated right next to the stable. The original plan also included a clubhouse, which can is found at the cape at the top of the map. However, the clubhouse was never built.




*Nuojua residential area, 1949. Map: Aarne Ervi. © Fortum Power and Heat.*




*Engineer's house 1 in Nuojua. Photos: Samuli Paitsola © Council of Oulu Region. Drawing: Aarne Ervi © Fortum Power and Heat.*

Aarne Ervi and his office designed all the buildings, interiors and landscaping. Nuojua is one of the finest examples of Ervi's housing areas and is also fairly well maintained. This area highlights Ervi's sense of scale and understanding of material. The buildings are placed carefully in an open, park-like landscape that separates the buildings from the surrounding wilderness. Ervi himself wrote:

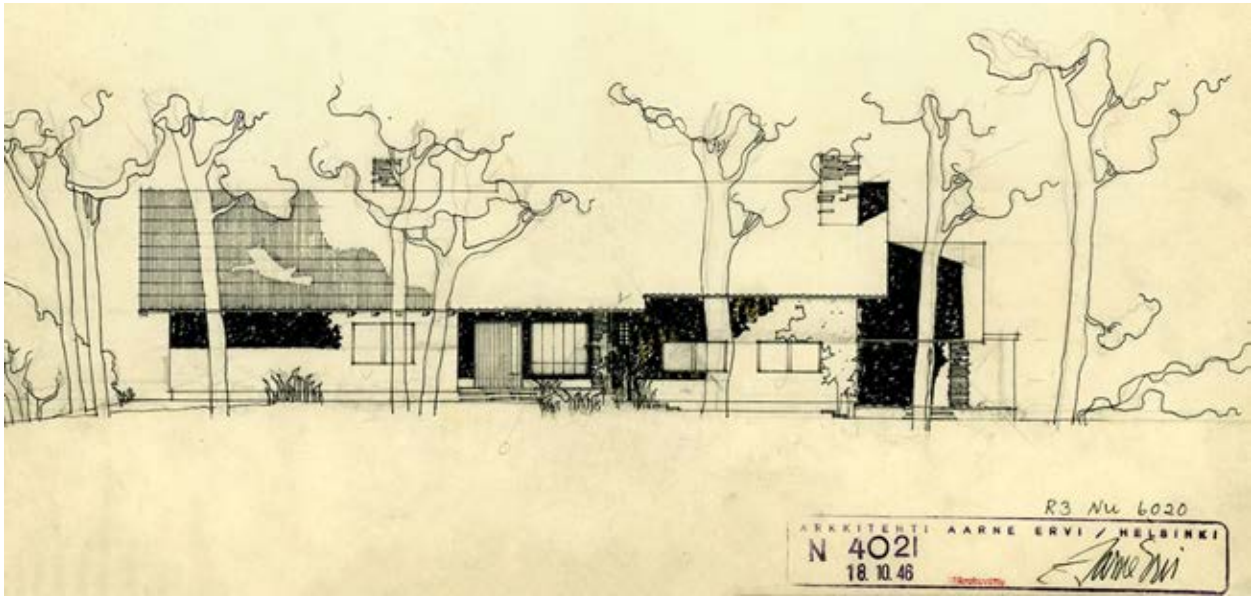
*"Residential areas, but especially Nuojua, are usually built on a beautiful but also favorable sites, that, for their part, have greatly inspired the architect"*[1]

In Nuojua, the frames for the buildings were assembled from Betocell blocks. These buildings were cladded with brick that have been rendered white and they have tile roofs as well as on-site cast concrete foundations. The windows frames and doors are made of wood.

The architecture of these buildings can be described as functionalist with regionalist and romantic undertones. This is apparent in Ervi's choice of material: wood, slate, plaster and glass. These materials, the scale and the overall disposition, all create a composed relationship between the buildings and the surrounding nature. It is also noteworthy that Ervi used porches and verandas as liminal, transitional spaces to connect the interior with the exterior. The two largest houses are reserved for engineers and have the best and most private lots. Engineer's house 1, at the end of the road, is probably the most luxurious and spacious of all of the private houses built for the whole project. The hierarchical order of the building also reflects the values of the time with separate floors for the residents and for the service staff. The bedrooms, the living room and the terrace are equipped with a view to the river.

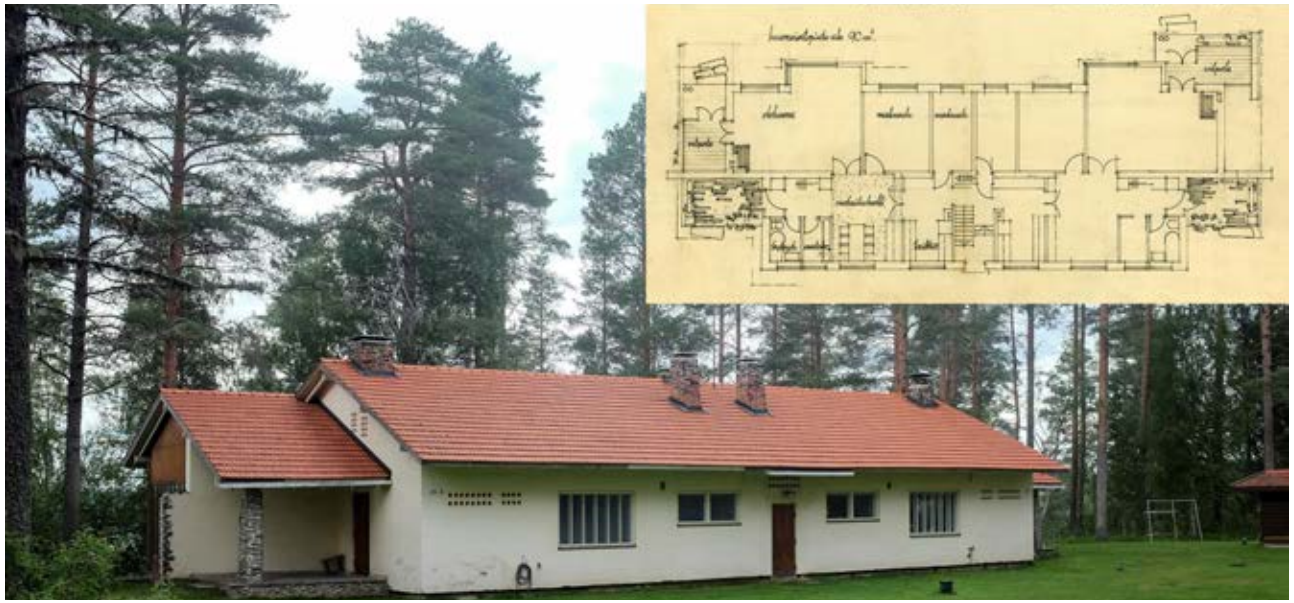
1 Ervi in Finnish Architectural Review 11-12, 1949

*Engineer's house 1, southeast elevation. House number 1 on the map. Photo: Pekka Elomaa © Council of Oulu Region.*




*Engineer's house 1, southeast elevation. Drawing by Aarne Ervi. © Council of Oulu Region*

Engineers house 2 is a luxurious and well-equipped single-family home at Nuojua. The building is a scaled-down, one-story, version of engineers house 1, while maintaining most of the main features. The main materials are wood, slate, plaster and glass. The building has a frame made of lightweight concrete blocks and a tile roof.



*Ervi, engineers house 2, Nuojua residential area, ground plan. Photo: Samuli Paitsola © Council of Oulu Region.*

The Nuojua service building had the usual functions: sauna, laundry room, bakery, boiler room and garages. It also had one apartment. The building is still in use and in in reasonably good condition.

*Service Building of Nuojua. Photo: Pekka Elomaa © Council of Oulu Region.*

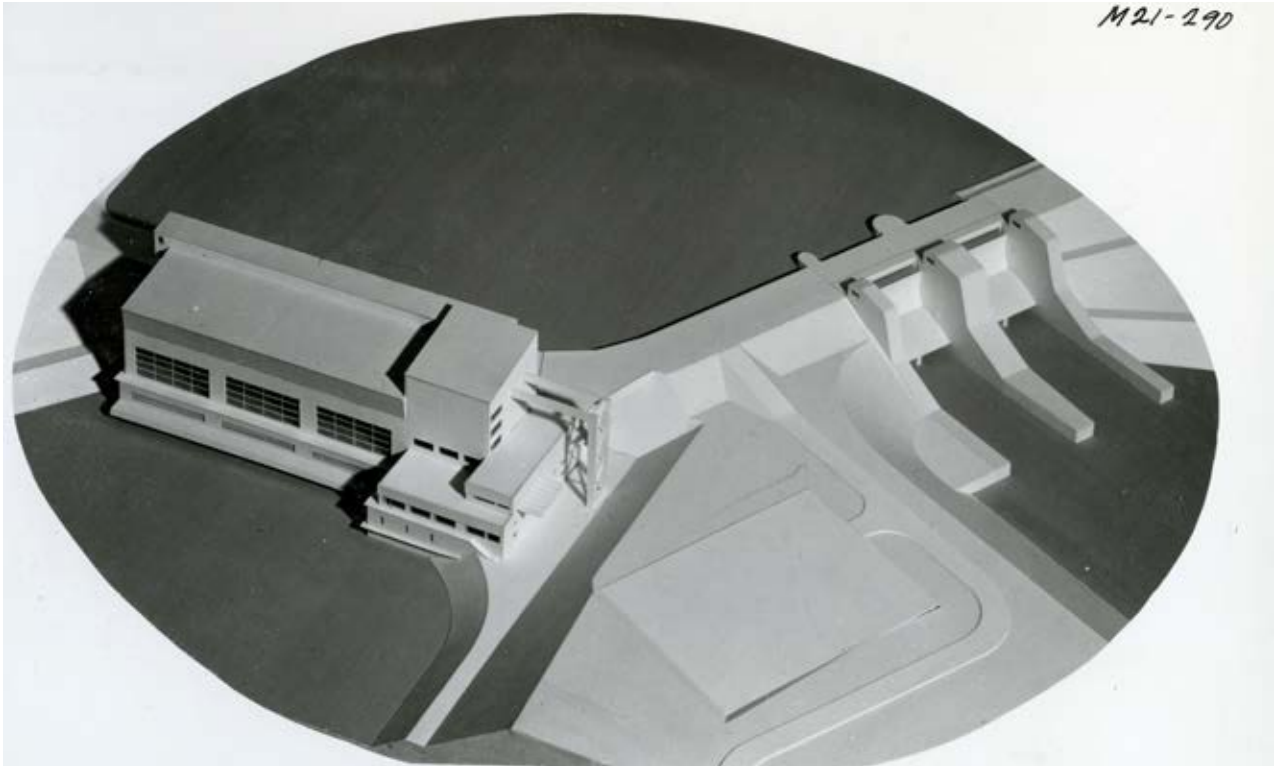
# 5.1.6 Montta

The Montta power plant is located approximately 2.5 kilometres southwest from Pyhäkoski. While Montta was built at the same time as Pälli, it was completed several years later.

The construction site was challenging because Montta is located over the tectonic depression of Muhos. Due to the geotechnical surveys of the 1930s, it was known that the bedrock at Montta was covered with hundreds of metres of clay stone and this was in turn covered by a thick layer of moraine.[1] To address this challenge, the builders needed to introduce construction methods that had never been used in Finland.

Work began in 1951 by building the roads and a railway to the area. Early in 1952, a 400-metre-long temporary dam was completed on the north shore of the rapids. The short canals were also finished. During construction, almost half a million cubic metres of earth had to be removed. Even so, the foundations of the powerhouse could not reach the bedrock and had to be constructed on top of the clay stone[2].

The frame of the powerhouse was cast out of concrete on the site and the façades were assembled with precast panels. Layers of moraine and till under the earth dam were compressed by using a method that was completely new in Finland: the ICOS-Veder method.[3]




*Scale model of Montta power plant. Photo: Fortum Power and Heat.*

The turbines for the power plant were supplied by a Finnish company, Tampella, and the generators by German AEG.

The regulating dam was built with bottom gates in addition to the usual radial floodgates, enabling the whole forebay to be drained empty when necessary. As the topsoil consisted of fine sand and silt, the riverbanks below the dam were also fortified by concrete plates.[4]

Regardless of the challenging conditions, the first set of machinery was connected to the power grid on 16 November 1955, the second on 16 June 1956 and the third on 18 February 1957. At the same time, while the power plant was being built, the Montta fish hatchery was also constructed. The farming began in the autumn of 1955.

*1 Kuuskoski 1991, 40*
*2 Enbuske 2010, 318*
*3 Kuuskoski 1991, 40-41*

*4 Kuuskoski 1991, 40-41*

## Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1951–1957
**Architectural design:** Aarne Ervi, architect
**Structural design:** Veikko Axelson, Osmo Korvenkontio, Veli Lehtonen, Harri Sistonen, Ilkka Paaja
**Machinery:** Three Kaplan turbines with vertical axis
**Capacity:** 47 MW,
**Head**: 12,2 m
**Flow**: 450 $m^3/s$
**Powerhouse:** On-site casted concrete frame, cladded with precast concrete panels.
**Dams:** Concrete regulating dam with two spillway openings and radial gates.
**Special features:** Montta fish hatchery
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes), Docomomo site
**Zoning status**: Master plan

*Montta powerhouse. The regulating dam can be seen on the left. Photo: Pekka Elomaa © Council of Oulu Region.*

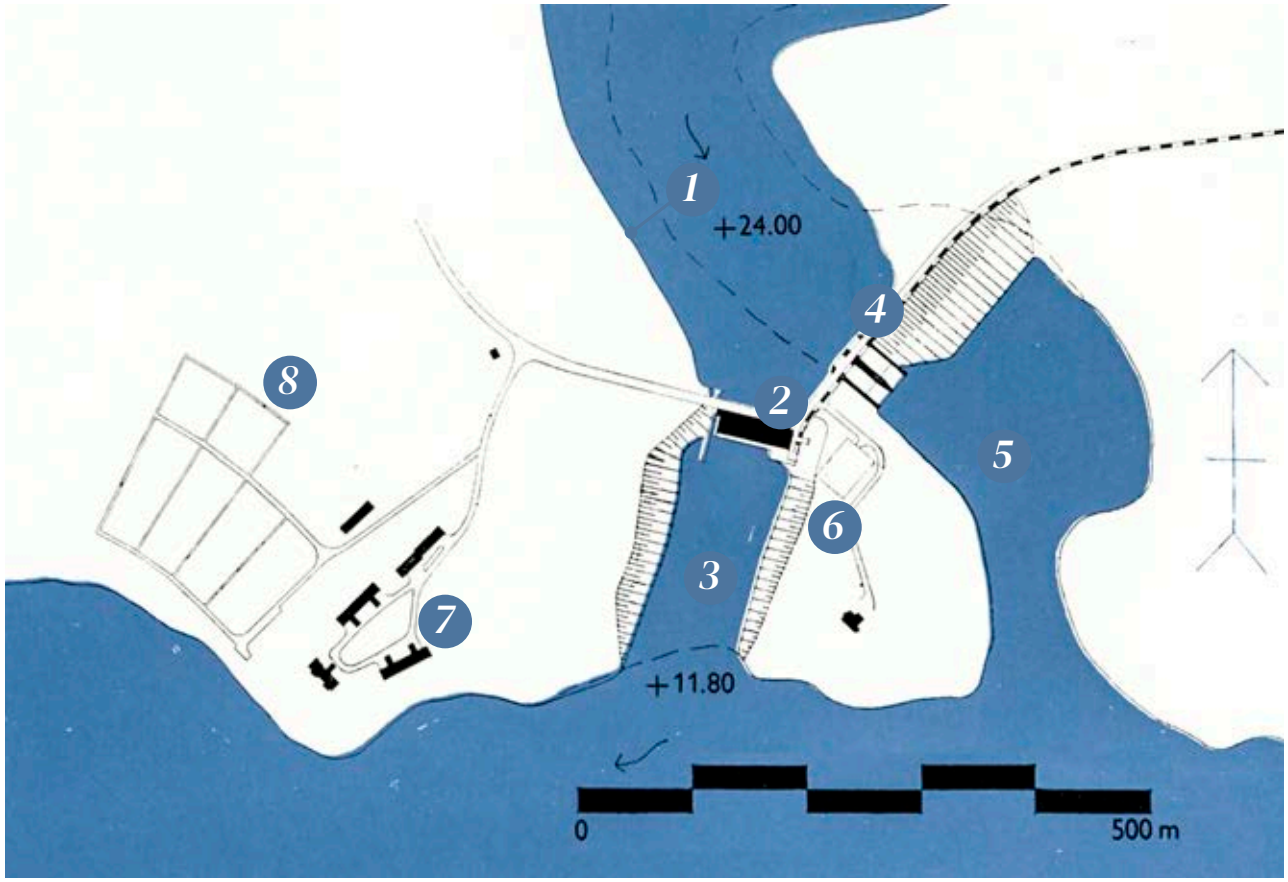

*Montta is located along the River Oulujoki in Muhos municipality about 5 kilometers from the downtown of Muhos and about 36 kilometers southeast from Oulu.*
*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement

Water is directed from the forebay (1) to the powerhouse's (2) three turbines through the intake gaps and released into the tailrace (3) that is mined through the Kämäränniemi cape.

The regulating dam (4) has two spillways openings with radial gates as well as sluice gates at the bottom of the openings. The flood water is released into the old riverbed (5). The switchyard (6) is built on the eastern side of the powerhouse.

The residential area (7) is located on the west side of the power plant. The Montta fish hatchery (8) is located right next to it.




*Site map of Montta. Oulujoki Power Company 1959, 36.*


*Montta powerhouse during construction in 1954. Photo: Foto Roos © Fortum Power and Heat.*

## Architecture

Montta was perhaps the power plant where Ervi's modernist aspirations reached its highest levels. Some of the features that underlined these aspirations were the transparency and clarity, the flow of light and space, the curtain-like walls and the concrete frame cladded with prefabricated panels. Learning from past problems he encountered, Ervi was able to articulate his vision in a clear and convincing manner in Montta.

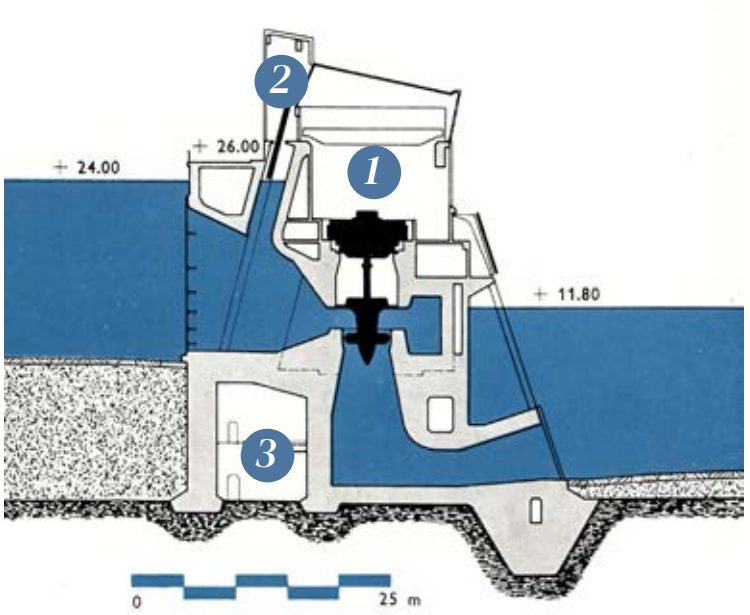
As in all of these power plants, certain conditions and circumstances dictated the basic premises for the overall design. The regulating dam was to be built in the old riverbed and the tailrace was going to be pierced through the Kämäränniemi cape. Montta is also different from other power plants on the River Oulujoki in that the powerhouse and the regulating dam are separated in the arrangement. The railway was built from the east and this also affected the overall disposition.

The speciality as well as the challenge of Montta was its soil, which meant that the powerhouse and the dams had to be constructed on a layer of claystone and moraine. The solution was the ICOS-Veder method where the ground is bored with holes that were 60 cm in diameter. During the drilling, the holes are densified by a special Bentonite clay mixture. After this, the holes are then filled with concrete, forming a continuous concrete wall. In Montta this cut-off wall is 40 metres deep in some places and it reaches below the moraine layer and into the clay stone[1]. The picture on the right shows how this method was used when building the embankments. This was the first time that this method was adopted in Finland and it consequently attracted widespread attention.

*According to the ICOS-Veder method, 60-cm holes are bored into the ground. The holes are then filled with concrete, forming a continuous concrete wall under ground. Photo: Foto Roos © Fortum Power and Heat.*

*1 The Oulujoki Power Company 1959, 34*

Montta has a head of only 12 metres and as a consequence, the powerhouse has a narrow and horizontal mass where the machine hall (1) and gate hall (2) amalgamate into each other. The most conspicuous feature on the western façade of the powerhouse is the thin slab of the gate hall. The unique aspect of the Montta powerhouse is that the maintenance gallery (3) has a basin for fish farming.



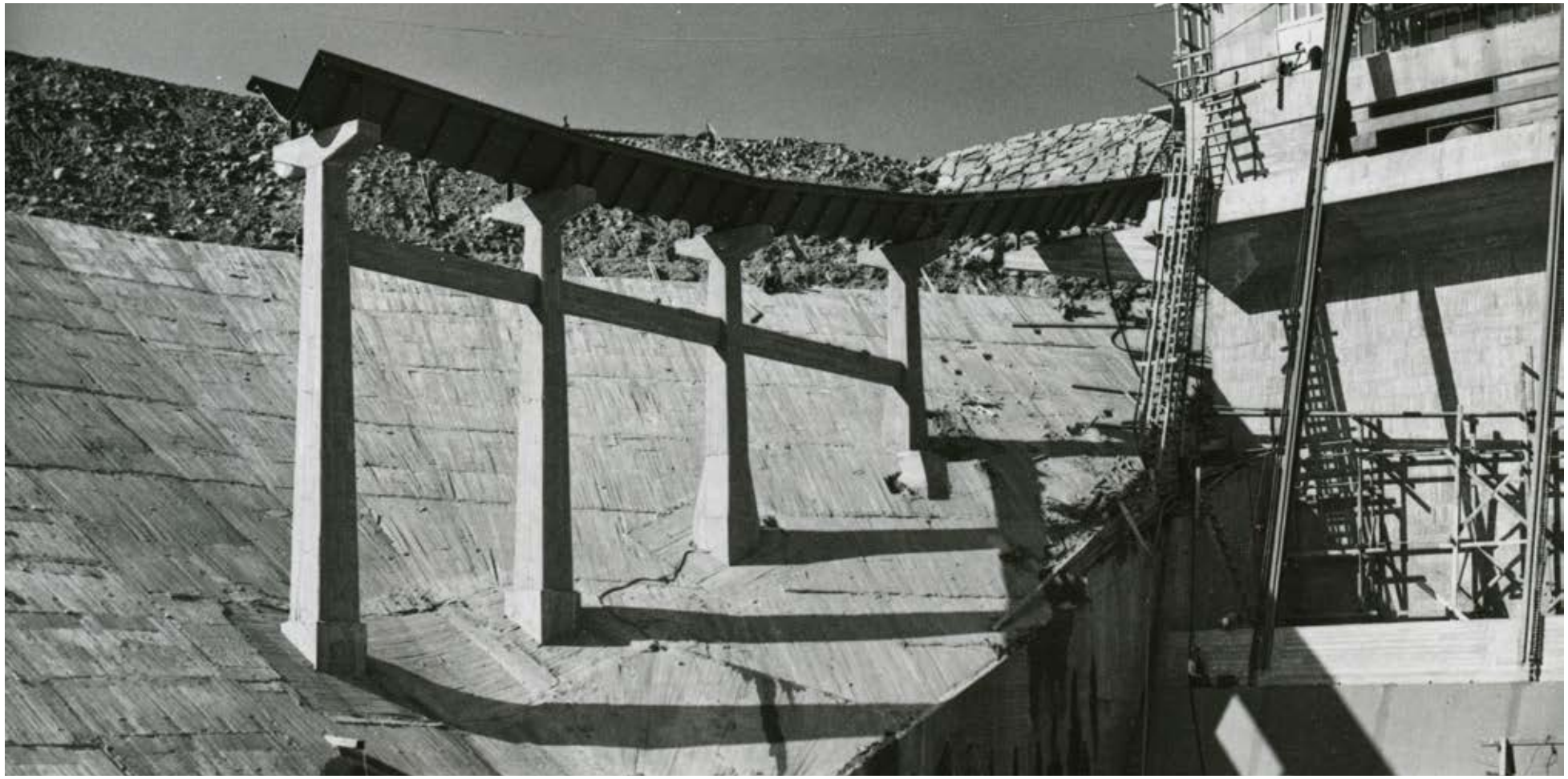

*Section of the Montta powerhouse. © Fortum Power and Heat.*

The pictures taken from the tailrace during construction reveal the overall tectonics of the building as well as the horizontal arrangement. The main mass has three monolith sequences, one for each turbine. In the buildings structural hierarchy, the massive casts of the draft tubes form the ground level.

Moving upwards, the constructions becomes lighter. The coupled columns form the load-bearing structure of the machine hall and also function as a mount for the beams to which the façade panels are attached. The columns also have a movement seam between them.

The steel grid supports the roof of the powerhouse as well as the upper section of the façade that has sheet metal cladding.

*The Montta powerhouse in 1954. Three monolith sequences form the main mass of the building. Photo: Foto Roos © Fortum Power and Heat.*



*This dramatic concrete log chute of Montta has been demolished. Photo: Foto Roos © Fortum Power and Heat.*

Montta features some of the most dramatic concrete structures in all of the power plants. The regulating dam is built in the old river bed separate of the powerhouse. In addition, with the radial gates, the two concrete spillways also have sluice gates at the bottom of the openings, making it possible to drain drain the forebay completely if necessary. The walls of the excavated tailrace were reinforced with concrete and the necessary means to float logs were constructed, first a log chute and later a machinery for lifting log bundles over the dam.

Today, the log chute, which for some might evoke images of ancient Roman aqueducts, has sadly been demolished, as has the machinery for the log lift.

Ervi composed the façades of the powerhouse harmoniously. The sandwich panels have a similar distribution to the windows and to the sheet metal cladding on top of the façade. The horizontal shape of the powerhouse gives a strong sense of openness, lucidity and space. The terraced block at the eastern end is reserved for the service area of the powerhouse.

*Montta powerhouse seen from the tailrace. The moveable control gate makes it possible to drain the turbine chamber during maintainance. Photo: Pekka Elomaa © Council of Oulu Region.*

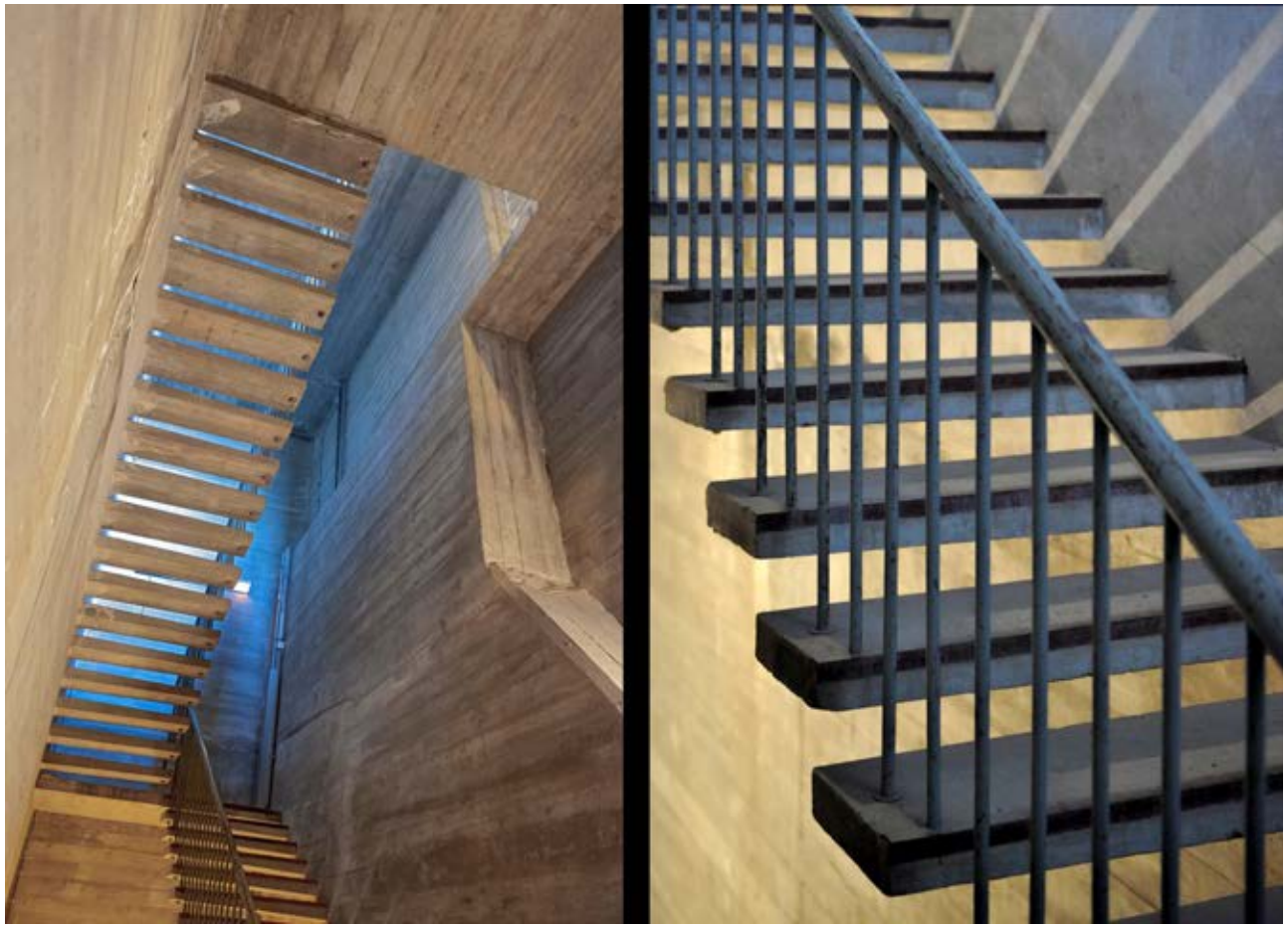
The Montta machine hall is nearly in original condition. The striped, blue concrete flood creates a sense of movement in the space while the blue back wall implicates the water as an element that is ever present as well as a source of power.

The wall facing the tailrace is assembled out of window elements and gives the hall its atmosphere that is open and flowing. Unfortunately, the machine hall has the same drawback as Pyhäkoski and Pälli, as the space is cut vertically in half because of the fluorescent lights that have been added halfway up the wall.

*Machine hall of Montta is largely in its original form. Photo: Pekka Elomaa © Council of Oulu Region.*

The staircase chasm at the western end of the powerhouse is dizzying in its height, as it reaches from the bottom of the river to the top floor. The concrete cast is almost 70 years old and remains in excellent condition.

The open riser stairs are elegant and minimalist in their design, as the stairs are cantilevered such that no additional supportive structure is needed.



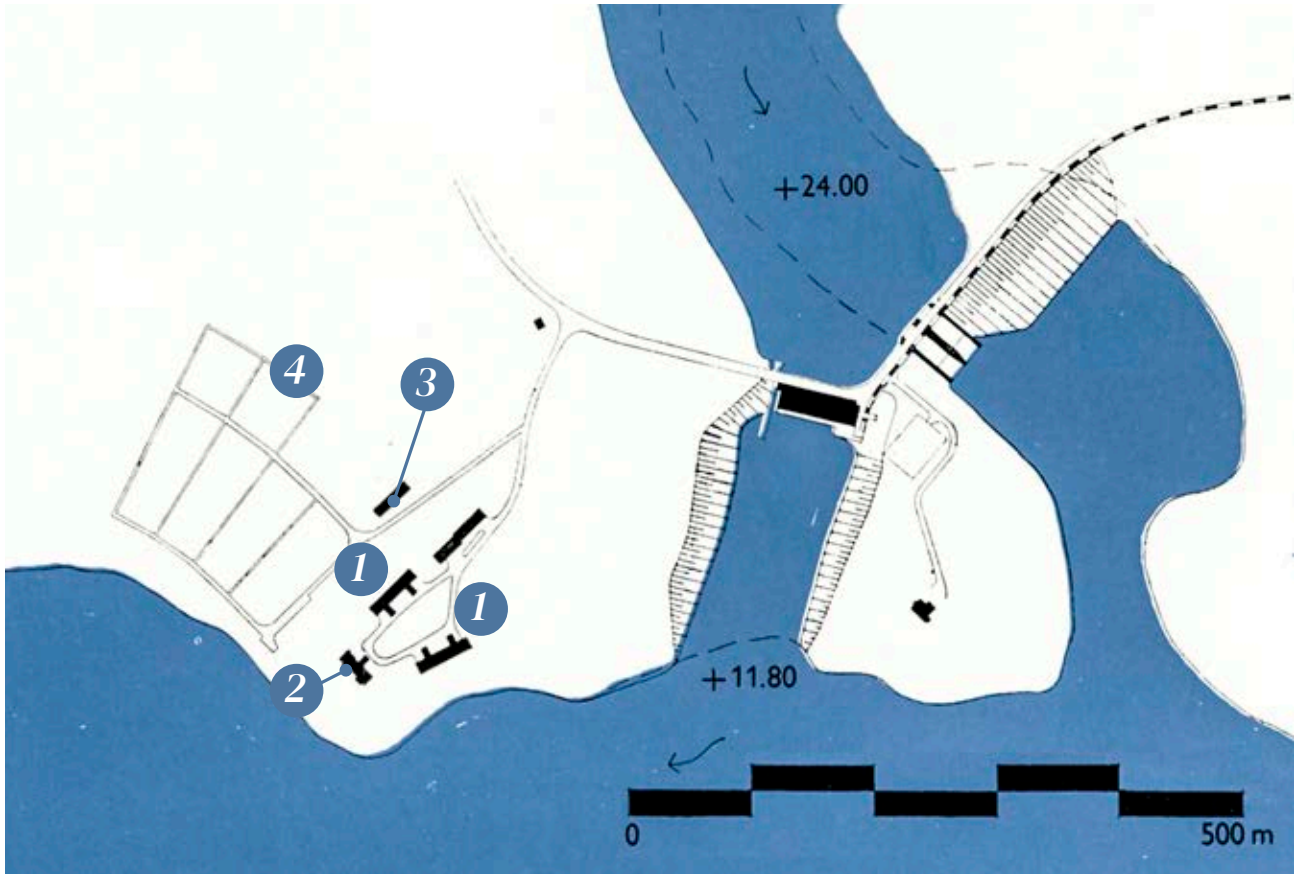
*Concrete stairs at Montta powerhouse. Photo: Pekka Elomaa © Council of Oulu Region.*

## Residential area

Montta has a small residential area built between 1951–1952. The houses are situated around a circular road near the waterfront. The buildings and the plan was designed by Aarne Ervi and his office. The area has a parklike setting that is well preserved. The original outdoor storates have been demolished and new storages have been built during the 1980s. Ervi also placed a playground at the centre of the area.

The area has two four-apartment row houses (1) built for the duty officers and a semi-detached two-family house (2) built for the officers. There is also a service building (3) in the area that has a boiler room, a sauna, a bakery, laundry room, and a garage. This building also has two apartments.

The company was also obliged to reimburse the damage caused to the local fishing industry by building a fish hatchery northwest from the residential area. This fish hatchery also has buildings designed by Aarne Ervi and his office.

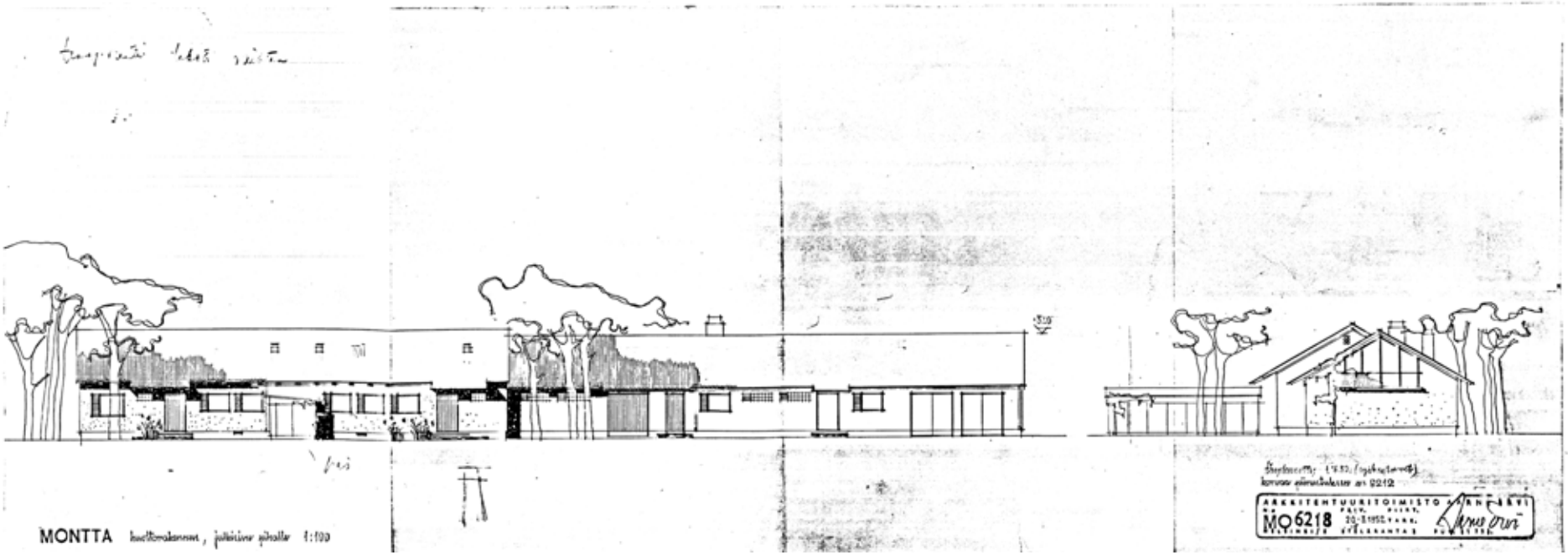



*The residential area of Montta. Oulujoki Power Company 1959, 36.*

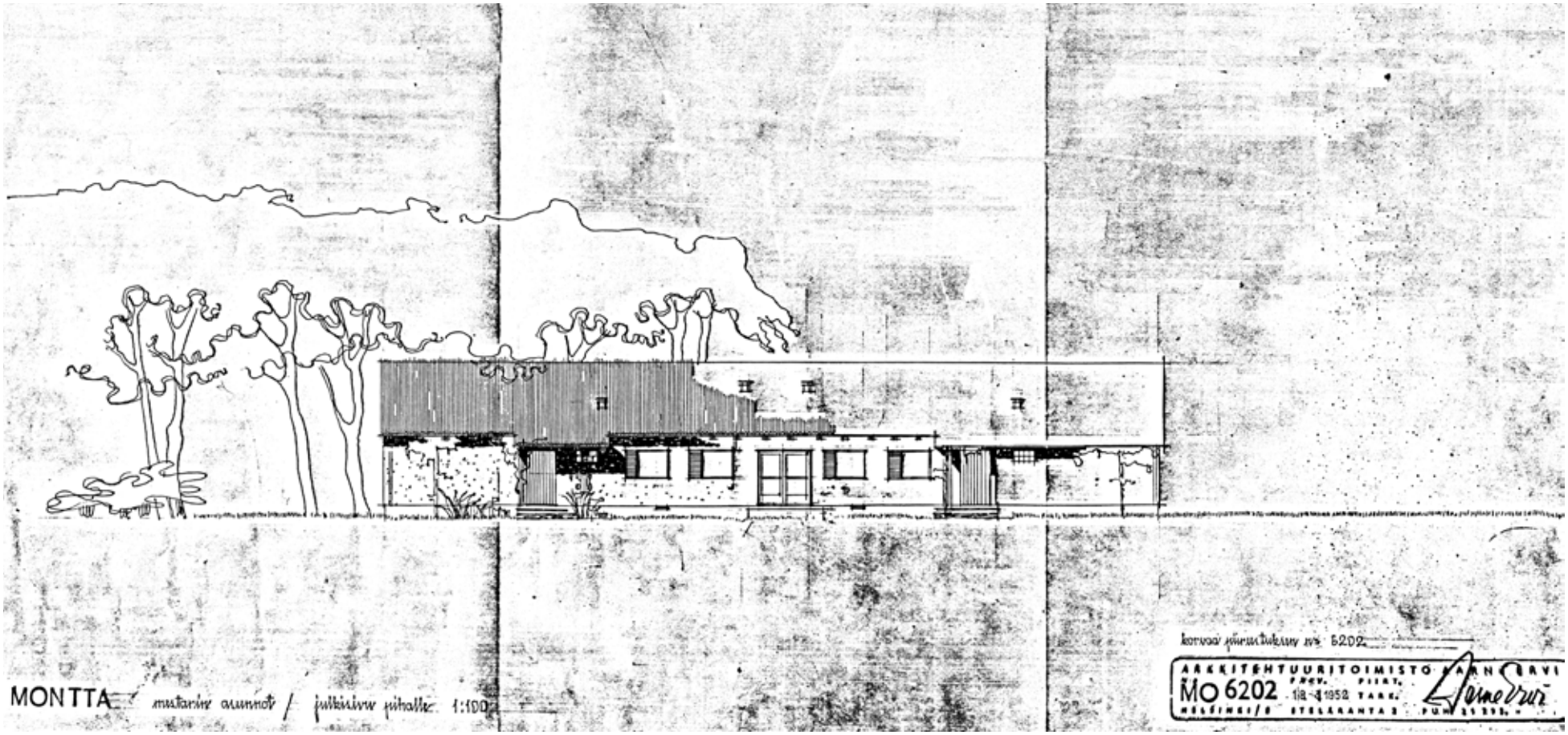
*The Montta residential area in the 1950s. The row houses were built on the sides and the semi-detached two-family house at the back of the area. Photo: Foto Roos © Fortum Power and Heat.*

In Montta, Ervi placed the buildings in a harmonious layout by the water and most of the apartments have a view to the river. The houses are made of lightweight concrete frames that are cladded with plastered brick. The foundations are cast out of concrete. All of the buildings have tile roofs, which is a characteristic feature of the buildings by Ervi.

The houses in Montta have one floor and an unheated basement. The windows, doors and façade details are made of wood. It is also important to note the use of slate in the landscaping details. The service building has a communal sauna, washing room and a bakery. This building also has two garages, and a boiler room that originally provided the heat for the apartments. It also had two garages. Later, additional garages were built in the courtyard and the original yard storage spaces have been replaced by new ones. Later, the two row-houses also had porches constructed on both sides of the building. This has altered the appearance to some degree.




*Ervi, the service building for the residential area of Montta, southeast and northeast elevations. The service building has two apartments, a communal sauna, washing room and a bakery. It also has a boiler room and two garages.*
*© Fortum Power and Heat.*




*Ervi, officers house in Montta, southwest elevation. © Fortum Power and Heat.*

The house for the officers has the most luxurious apartments in Montta. This semi-detached two-family house was built at the back of the area. The house was built with the same structural logic and materials as the row houses but the apartments are larger and the interiors more prestigious.

Today the apartments in Montta are inhabited and the houses are mainly in good condition. Few alterations have been, the biggest being the porches and patios that have been added. This has somewhat changed the overall appearance of the houses. The interiors have understandably also undergone many changes throughout the years.

The fish hatchery located right next to the residential area is also still active. The facility has gone through a big renovation and improvement in 2015. The hatchery is owned by Fortum Power and Heat.

# 5.1.7 Utanen & Ala-Utos

Utanen was the last power plant built on the River Oulujoki, thus completing the power plant chain along the river. Preparatory work for Utanen began in late 1952 by building temporary housing and service buildings. The actual residential area was built later in the 1950s. Construction of the power plant began the following year. The north side of the dam was completed at the end of 1953 and the southern side soon after this. The sets of machineries were ordered from two Finnish companies, turbines from Tampella and generators from Strömberg.[1]

The earthworks for the tailrace began in spring 1954. The canal excavations were extensive. Almost 4 million cubic metres of rock had to be removed. To accomplish this, 9 diggers, more than 10 bulldozers and 30 heavy tip lorries were assigned to the task. This turned out to be the largest earthmoving job in Finnish history[2]. During the rock blasting, the people living in Utajärvi had to remain indoors and the Oulujoki Power Company paid them 100 Mk per blast[3]. The powerhouse has an in-situ concrete frame and the façades were constructed from precast panels and sheet metal.

In May 1956, water was released into the reservoir. The tailrace was completed at the end of the year and the first set of machinery was connected to the power grid on 19 November 1956. Due to the long tailrace, the landscaping went on for decades.[4] The second set of machinery was connected to the power grid late in 1956 and the third in summer 1957. The production of electricity began in autumn 1957. Utanen has a maximum capacity of 58 MW, which makes it the third-largest power plant on the River Oulujoki.

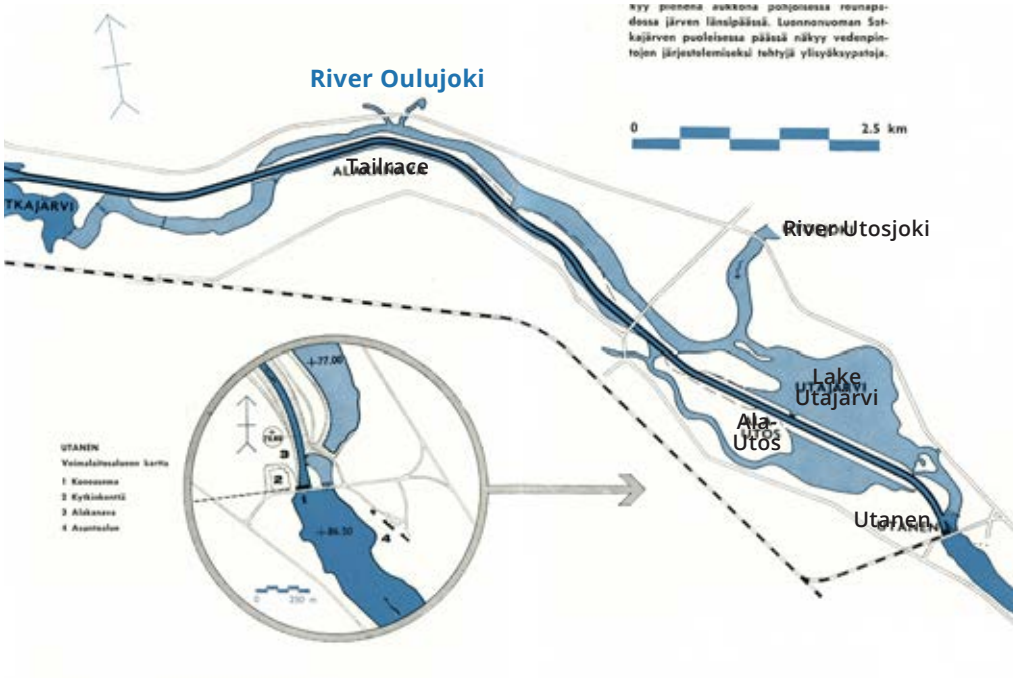
*1 Kuuskoski 1991, 42-43*
*2 Enbuske 2010, 319*
*3 Ibid, 319*
*4 Kuuskoski, 1991, 43-44*

*Powerhouse of Utanen seen from the tailrace. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1952–1957
**Architectural design:** Aarne Ervi, architect
**Structural design:** Veikko Axelson, Osmo Korvenkontio, Veli Lehtonen, Harri Sistonen, Ilkka Paaja
**Machinery:** Three Kaplan turbines with vertical axis
**Capacity:** 58 MW,
**Head**: 15,6 m
**Flow**: 450 m³/s
**Powerhouse:** On-site casted concrete frame, cladded with precast concrete panels and sheet metal.
**Dams:** Concrete regulating dam with two spillway openings and radial gates.
**Special features:** 12 km long tailrace.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes), Docomomo site
**Zoning status**: District plan

## Location




*Utanen tailrace, site plan. Oulujoki Power Company 1959, 43.*

*Part of the completed tailrace which runs along River Oulujoki. Oulujoki Power Company 1959, 41.*

Utanen is located on the River Oulujoki in Utajärvi municipality about 500 metres upstream from Lake Utajärvi. The River Utosjoki flows from the north into Lake Utajärvi. Due to the extremely long tailrace, the effective area of the power plant stretches to 12 kilometres.

According to the original plan, the 16 m between Pyhäkoski and the rapids of Niskakoski was to be harnessed by two power plants. However, after the Oulujoki project proceeded and building costs continued to mount, the plan for two power plants was re-evaluated from an economic point of view.

It was then suggested that a tailrace of unprecedented length would be excavated through Lake Utajärvi all the way to Lake Sotkajärvi, which was located ten kilometres downstream. This meant that the whole head between Lake Nuojuanlampi and Lake Sotkajärvi could be utilised. At one point, extensive cost comparisons were made between Utanen and the large quarries in the United States. The construction of the tailrace required that a total of seven million cubic metres of earth had to be excavated.

When the Oulujoki project began, this type of excavation work would have been impossible, but in the 1950s, the company and its workforce had gained more experience and big machines were more available. As a result, the large-scale excavation and regulating works at Jylhämä, Pyhäkoski and Utanen were essential milestones in the development of Finnish earthworks.

*The spillways of the regulating dam under construction. Photo: Foto Roos c Fortum Power and Heat.*

## Architecture

Utanen was the last power plant built on the River Oulujoki, thus completing the power plant chain on the river. Utanen again represents a new phase in Ervi's design with evermore streamlined and "machine-like" aesthetics. The weighty monumentality and firm brickworks of Pyhäkoski seem rather old-fashioned when compared to the curtain walls and aerial horizontality of Utanen.

In Utanen, Ervi fitted only what was imperative inside the actual frame. For example, he placed the control gates on a platform outside the envelope of the building. The most significant feature of Utanen is its tailrace of 12 kilometres that was excavated through Lake Utajärvi and the River Oulujoki. When completed, the channel altered the landscape substantially.

The production of electricity guided the design process heavily in Utanen. The most massive part of the powerhouse is its three submerged draft tube openings. The three Kaplan turbines are placed at the centre of the openings, dictating the location of the machine hall. The powerhouse of Utanen is a hall-like structure and its light envelope enclosed all the spaces needed in the production process.

The architecture of the building is easy to read. The features that contribute to this are the diameters of the reinforced concrete frame, the measured structural details, and the high-quality, fair-faced, raw concrete that elegantly carries the lattice where the façade panels and the steel grid–supported roof are attached. The large opening, which is almost as wide as the northern façade, is not connected to the frame of the building.


*The Utanen powerhouse under construction. Photo: Foto Roos © Fortum Power and Heat.*

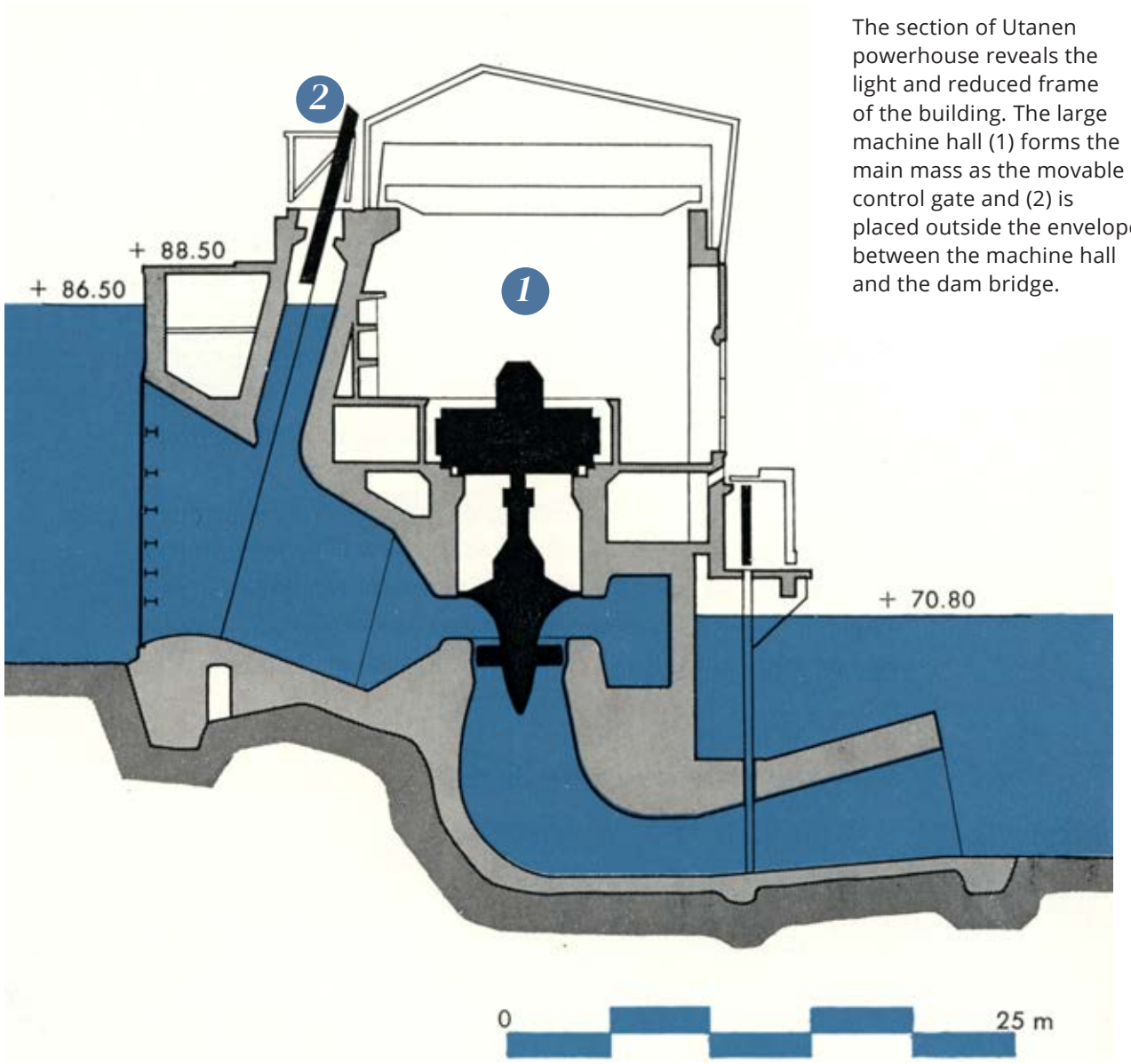
The façade functions as a curtain wall where the openings do not relate to the load-bearing frame. As a consequence, the northern façade consists almost entirely of glass. The architecture of the building is underlined by this tension between the simple and sturdy frame and the gentle details and materials. The mass of the powerhouse consists of four monoliths cast into the mined riverbed, one for each turbine and another for the maintenance area of the machine hall. The service area is built adjacent to the maintenance area. Above the draft tube openings, the loads are carried by sturdy (800 x1700 mm) concrete columns that have a movement seam between them. The beam for the tailrace bridge is supported by the consoles, which are also made of reinforced concrete. The upper part of the wall forms and the L-beam that supports the window frames above it are as wide as the whole façade.

The concrete beams running on top of the coupled columns in the machine hall also function as the girders for the crane that operates in the hall. The steady rhythm of the columns and the large window surface set the tone for this northern façade. The glass frames are attached to the large oak window frame. In addition, the inner window glass is attached using oak strips.

*Utanen in the summer of 1958. The power plant and the log chute are operational. Photo: Foto Roos © Fortum Power and Heat.*

Natural light floods into the machine hall and the glass surface constantly reflects its surroundings. A large steel door stands as a continuum to the glass curtain. This door has been replaced by a new one and has been unfortunately retracted, which means that the original effect of the continuous curtain wall is lost. The concrete façade panels are vertically profiled and have the same distribution as the sheet metal façade above it. These panels are attached to the concrete beams that are not visible outside.

The same curtain-like lightness is likewise dominant in the gables. The asymmetrical gable roof is supported by a steel grid.




The section of Utanen powerhouse reveals the light and reduced frame of the building. The large machine hall (1) forms the main mass as the movable control gate and (2) is placed outside the envelope, between the machine hall and the dam bridge.

*A section of the Utanen powerhouse. Oulujoki Power Company 1959, 42.*

When approaching the powerhouse from the west, its shallow shape creates a machine-like overall appearance. The girder crane built for lifting log bundles over the dam underlines this. Utanen is the only power plant that has retained the “claws” of the log crane. The crane functions as a monument to the diverse ways that the rivers have been utilised in the past. At present, the shores of the river are overgrown and this makes it more difficult to see the facility from the tailrace.

After Utanen was finished in 1957, the main channel of the River Oulujoki was completely harnessed for electricity production.[1] After this, the Oulujoki Power Company moved it organisation and construction infrastructure north to the River Emäjoki that flows from Lake Kiantajärvi into Lake Oulujärvi. On the River Emäjoki, the company designers, engineers and builders could utilise everything they had learned because the power plants in the north were almost mass-produced.

*Utranen is the only power plant on the River Oulujoki that still has the claw of the log crane. Photo: Pekka Elomaa © Council of Oulu Region.*

*1 Enbuske , 2010, 319*

*Ala-Utos in the summer of 2019. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Build:** 1956–1957
**Architectural design:** Aarne Ervi, architect
**Machinery:** One Francis turbine with horizontal axis
**Capacity:** 0,55MW
**Head**: 4,8-6,5 m
**Flow**: 10 $m^3/s$
**Powerhouse:** On-site casted concrete frame
**Dam:** Concrete regulating dam with one spillway openings and radial gate.

# Ala-Utos

While Utanen was being built, another, smaller power plant, Ala-Utos, was also being constructed on the side of the tailrace. Builders realised that they could drain the water that runs from the River Utosjoki into Utajärvi (Lake Utajärvi) through an ungated spillway on the embankment.

So the ungated spillway was replaced with a floodgate. A small powerhouse was built on the side and a log chute on the other side. The set of machinery was ready in the autumn of 1957 and the power plant began producing power with 0.5 MW capacity.[1]

This unmanned small-scale power plant is controlled from the Pyhäkoski power plant.

*1 Kuuskoski 1991, 44*

## Residential area

Utanen has a small residential area of approximately 200 metres located southeast from the power plant. This area was built in the mid-1950s and designed by Aarne Ervi and his office. The area consists of three houses that have been placed in a line formation on the shore of the River Oulujoki, upstream from the power plant.

The houses have one floor for living as well as a basement and an attic. The houses have yard storage places built in the front yard. The garage and workshop were built later, in the 1960s. The area also has a playground. Today, the houses are well-preserved and in good condition. The area itself has lost some of its original park-like atmosphere because the forest around it has grown.

The area consists of:

Semi-detached two family house
Row house
Service building
Garage
Workshop


*A row house of Utanen under construction. Photo: Foto Roos © Fortum Power and Heat.*

All the houses have a similar construction: a frame built out of Betocell blocks, a tile roof and a concrete foundation. The frame is cladded with brick that is plastered light yellow.

The Betocell blocks were manufactured on-site. The doors, windows and detailing are constructed from wood. The picture above show how the frame was built. The use of the Betocell blocks and standardised building parts made the construction fast and cost- efficient.

The architecture of the houses in the Utanen residential area follows the same principles, design logic and uses of the same house types that Ervi built elsewhere along the river.

*A row house in Utanen, back façade. Photo: Samuli Paitsola © Council of Oulu Region.*

The largest row house in Utanen consists of six apartments that were originally built for the officers of the powerhouse. The house is on a beautiful spot located on a gently sloping plot by the river.

This row house had the same structural components and materials as the other houses in the area. The original tile roof has been replaced by a similar material, but the addition of snowguards and ventilation units have altered its overall appearance.

The architecture of the building is unambiguous and creates clear lines with several ”trademarks” of Ervi’s design. An important feature concerns how the building interacts with its surroundings.

*A semi-detached house in Utanen. Photo: Samuli Paitsola © Council of Oulu Region.*

The semi-detached two-family house in the most prestigious and offers the largest apartments in the residential area of Utanen. The house was built for company engineers and officers. This house has a similar construction and the same materials as the row houses: a concrete foundation, tile roof, and a frame built out of Betocell blocks and cladded with rendered brick. The yard storage separates the two apartments front yards and gives the spaces more privacy.

The original roof tiles have been replaced by new ones. Fortunately, the new roof tiles are similar to the old ones and thus the original appearance has been preserved.

*The Utanen service building. Photo: Samuli Paitsola © Council of Oulu Region.*

The Utanen service building fulfilled functions that are similar to the other service buildings on the river (sauna and laundry room). It also included the boiler room that provided heating for the area. In addition, the house has four apartments. The building is in good condition and retains its original appearance with the exception of the added snowguards and ventilation units.

The original brick chimney of the boiler is still at the back of the house and is visible behind a tree. Like the other service buildings along the river, the service area of the building is no longer in use and the house is only partly inhabited.

*The chimney of the service building.*
*Photo: Samuli Paitsola © Council of Oulu Region*

# 5.1.8 Pikkarala Electricity Conversion Station

*The control room building of Pikkarala. Photo: Pekka Elomaa © Council of Oulu Region.*

*Pikkarala in summer of 2019. Photo: Pekka Elomaa © Council of Oulu Region.*

The electricity produced by the hydropower plants on the River Oulujoki had to be also transferred to other parts of the country. The greatest need for electricity was in the big cities and industry of Southern Finland.

The Imatra Power Company had the task to build a transfer grid from the River Oulujoki to Southern Finland. This was a large-scale venture. The Pikkarala transfer station is an integral part of this entity.[1]

It was built between 1955 and 1959 and designed by Aarne Ervi. The station has a control building, transformer substation and transfer building built with brick façades. The area also has a wooden single-family house built for the caretaker.[2]

*1 Enbuske 2010, 313*

*2 Huhmo 2017, 75*

# 5.2 The Sotkamo route

The Sotkamo route begins from Lake Ontojärvi near the Finnish-Russian border where the River Ontojoki flows westward towards Lake Oulujärvi. There are two power plants along the river, Katerma and Kallioinen, while the City of Kajaani has three power plants. Ämmäkoski is the oldest of these and dates back to 1917. Kajaani also has one newer plant, Koivukoski II, which was built in the 1990s. The remaining plants were completed during the 1940s and 1950s.
A majority of power plants and residential areas along the Sotkamo route was designed by the architect Eino Pitkänen.

**This chapter includes:**

# 5.2.1 Ämmäkoski

*The Ämmäkoski power plant as seen from the headrace. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Kainuu Ltd.
**Owner:** Kainuu Power Company
**Finished:** 1917, renovated 1940
**Architectural design:** Onni Tarjanne, renovation by Eino Pitkänen
**Structural design:** Hugo Malmi
**Machinery:** One Kaplan turbine with a vertical axis. Two older Francis turbines function as a backup machinery.
**Capacity:** 4,9 MW
**Head**: 6,5 m
**Flow**: 450 $m^3/s$
**Powerhouse:** On-site casted concrete frame, cladded with plastered brick.
**Dams:** Concrete regulating dam with six small spillway openings.
**Special features:** Located in downtown Kajaani. The powerhouse has been re-styled according to functionalist planning principles.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Detailed plan

Ämmäkoski is one of the three hydroelectric power plants in the City of Kajaani. Located on the River Kajaanijoki that flows through the city centre, Ämmäkoski is directly below Koivukoski I-II. The ruins of the medieval Kajaani Castle lie between the two power plants.

Ämmäkoski was originally constructed in 1917 and was designed by the architect Onni Tarjanne in cooperation with the hydropower engineer Hugo Malmi.

Ämmäkoski was built to produce power for Kajaani's industry that was located along the river and in the Petäisenniska area[1]. The powerhouse was built with an in-situ concrete frame and plastered brick cladding.

In 1940, Ämmäkoski was completely renovated by the architect Eino Pitkänen, who also designed the extension for the building. At the same time, the appearance of the facility was re-styled in line with the principles of functionalism.

A third turbine was also added and today the power plant produces 4.9 MW of electricity.[2] The newer Kaplan turbine was renovated in 2008. The two older Francis turbines currently function as backup machinery.

The city's business district, also designed by Pitkänen, is located directly next to the power plant. This district was built according to functionalist planning principles during the economic boom of the 1940s and 1950s.[3]

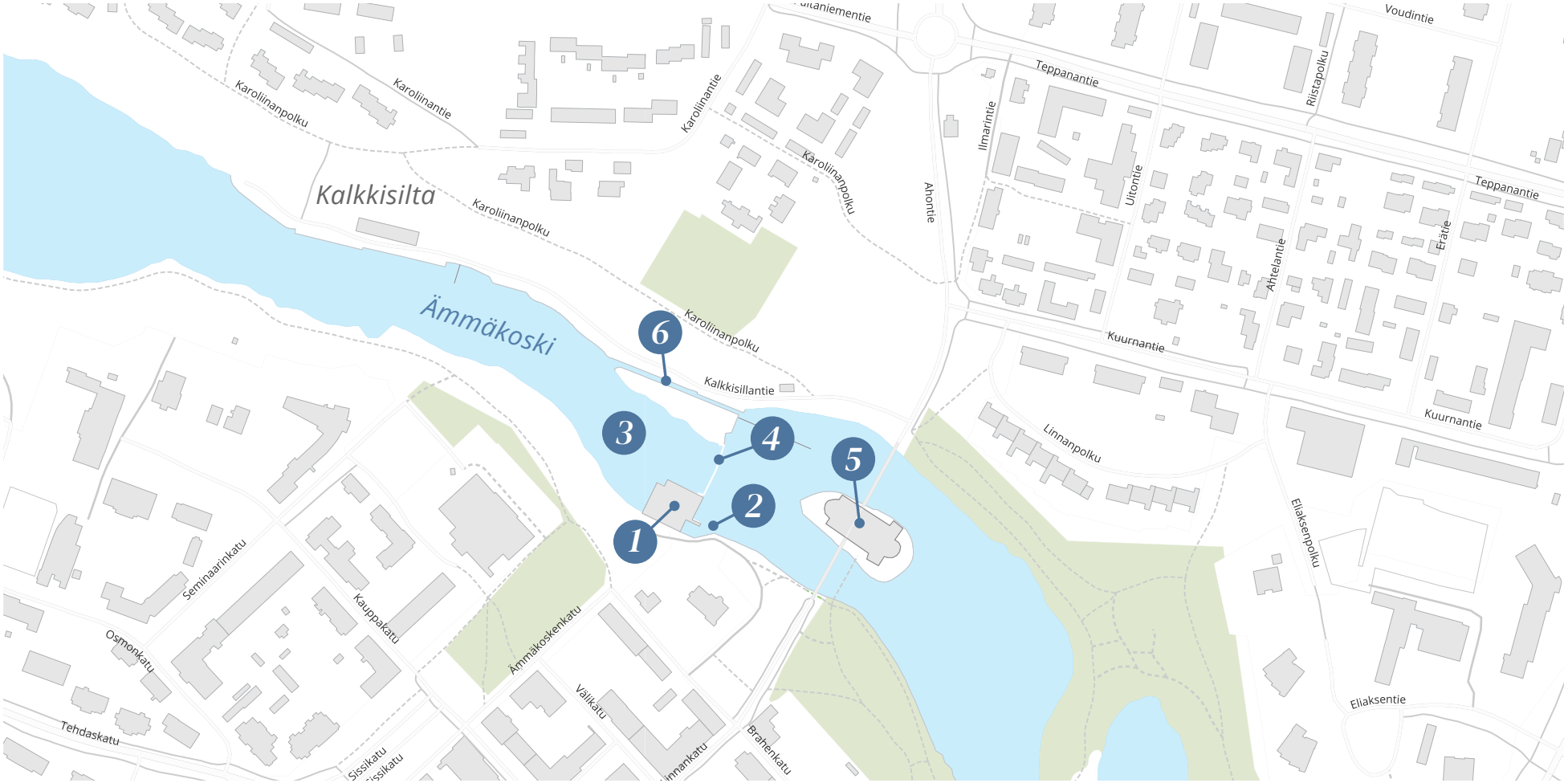
*1 Huhmo 2017, 84*

*2 Ibid, 85*
*3 Karoliina Kikuchi, 2020*

*The regulating dam of Ämmäkoski. Photo: Pekka Elomaa © Council of Oulu Region.*

## Location


*Ämmäkoski is located in the city centre of Kajaani in the Kainuu region. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*




*Map of the city centre of Kajaani. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement

The powerhouse (1) is built on the southern bank of the river in the city centre of Kajaani. The water is directed into the turbine through a short headrace (2). The riverbed functions as the tailrace for the plant (3).

The regulating dam (4) consists of six small spillway openings and these almost completely close the river. The ruins of the medieval Kajaani Castle (5) are located next to the power plant. The old channel for the tar boats (6) is located in the northern riverbank.

*The Ämmäkoski powerhouse and regulating dam. The rustic natural stone facing is used as an architectural reference to the ruins of the medieval Kajaani Castle. Photo: Pekka Elomaa © Council of Oulu Region..*

*The machine hall of Ämmäkoski. Photo: Pekka Elomaa © Council of Oulu Region.*

## Architecture

After the original Art Nouveau -stylings of Onni Tarjanne, the powerhouse of Ämmäkoski was renovated and completely restyled in 1940. The task was given to architect Eino Pitkänen who gave the building an up-to-date modernist appearance. He also designed the extension for the building.

The building now has a simple rectangular shape with minimal detailing and decorative features. Traces of Tarjanne's original design are still evident in the circular windows of the façade and in the rustic natural stone facing, which is used as an architectural reference to castle ruins.

Today, the Ämmäkoski power plant is an integral part of the modernist city centre of Kajaani.

*Tarjanne's original vision with the Art Nouveau-esque motives visible in the interior of the powerhouse. The two, old, Francis turbines function now as backup machinery. Photos: Pekka Elomaa © Council of Oulu Region.*

# 5.2.2 Koivukoski I-II

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Kajaani Timber Company
**Owner:** Kainuu Power Company
**Finished:** 1943
**Architectural design:** Eino Pitkänen, architect
**Machinery:** Two Kaplan turbines with vertical axis
**Capacity:** 6.5 MW
**Head**: 9 m
**Powerhouse:** In-situ concrete frame, plastered brick facades
**Dams:** Concrete regulating dam with two spillway openings and radial gates
**Special features:** Large gable window, situated in downtown Kajaani
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: District plan

*Powerhouse of Koivukoski I-II The main mass of the powerhouse incorporates three rectangular blocks with each block having different functions. Photo: Pekka Elomaa © Council of Oulu Region.*

Koivukoski I-II is located on the River Kajaanijoki that flows through downtown Kajaani. It is in the vicinity of the ruins of the medieval Kajaani Castle.

The power plant, designed by architect Eino Pitkänen, was finished in 1943. The powerhouse has an in-situ concrete frame and plastered brick cladding. The power plant was originally built Kajaani Timber Company for its private use. The plant was acquired by Kainuu Power Company in 1995. Nowadays the plant produces power for the company's customers.

The power plant has two turbines and a maximum production capacity of 6.5 megawatts. The machinery and the facades of the powerhouse and the regulating dam were renovated between 2008-2010.[1]

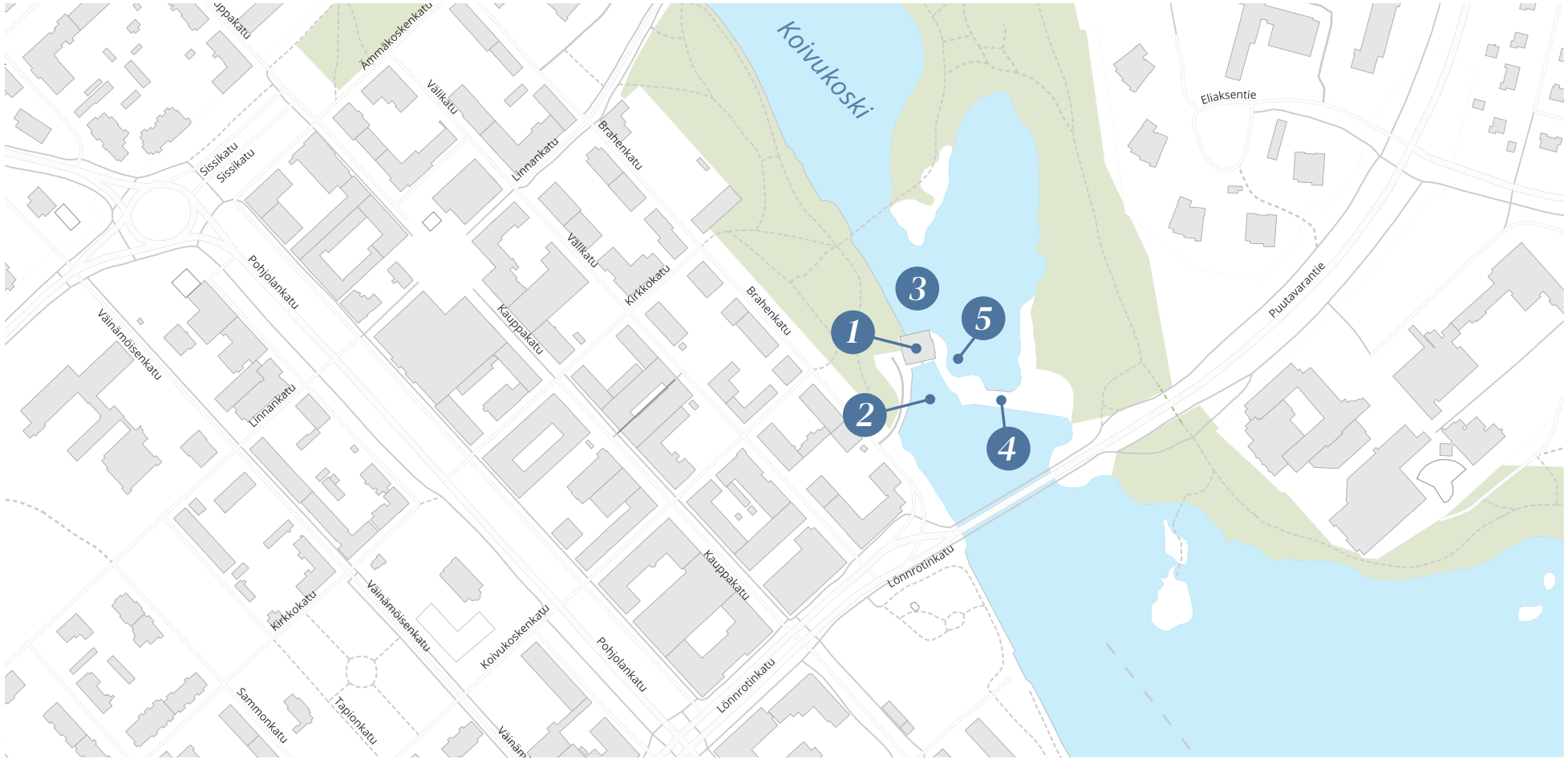
The city's business district was built in accordance with the functionalist planning principles during the economic boom of 1940s and 1950s by Eino Pitkänen. Koivukoski I-II is part of this modernist city centre.[2]

*1 https://www.kainuunvoima.fi/yritys/historiaa/*

*2 Karoliina Kikuchi, 2020*

## Location


*Koivukoski I-II is located in the Kajaani city centre in the Kainuu region. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*




*Site map of Koivukoski I-II. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement

The powerhouse (1) was built on the southern bank of the river in the Kajaani city centre. Water is directed into the turbines through a short headrace (2) and released into the river (3).

The regulating dam (4) has two spillway openings with radial gates. The remains of the old, concrete log chute (5) are located on the eastern side of the powerhouse.

*Koivukoski I-II as seen from the headrace. Photo: Pekka Elomaa © Council of Oulu Region*

## Architecture

The main mass of the powerhouse incorporates three rectangular blocks with each block serving different functions. The machine hall is located at the centre with the office block on one side of the tailrace and the gate hall on the other.

The large windows at the gable flood the interior with light and open the view from inside the building towards the city centre. The façades are rendered white while the dark-brown pilasters and window frames provide contrast and rhythm.

Other noteworthy architectural features are the small engine rooms that control the gates of the regulating dam as well as the concrete log chute that remains intact.


*The most notable features of the machine hall of Koivukoski I-II are the generators and the girder crane operating in the ceiling. Photo: Pekka Elomaa © Council of Oulu Region.*

# 5.2.3 Katerma

*Powerhouse of Katerma seen from the tailrace. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Kajaani Ltd.
**Owner:** UPM Energy
**Built:** 1945–1950
**Architectural design:** Eino Pitkänen, architect
**Machinery:** One Kaplan turbine with vertical axis
**Capacity:** 10 MW
**Head**: 12,5 m
**Powerhouse:** In-situ concrete frame, plastered brick facades
**Dams:** Earth dams and concrete enforced embankments along the headrace. Concrete regulating dam with one spillway opening and a radial gate in the old riverbed.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Regional plan

Katerma is located on the River Ontojoki in the municipality of Kuhmo near the Finnish-Russian border and is one of the power plants on the Sotkamo route waterway. The architect who designed the power plant was Eino Pitkänen and the construction was started by Kajaani Ltd. in 1945. Due to the post-war shortages, the construction lasted five years and the facility was completed in 1950.

The powerhouse sits at the end of a long headrace that was excavated through a neck of land. The old riverbed circles around the facility. The log crane is placed apart from the powerhouse and a separate channel leads to the crane. The powerhouse has one machinery even though the original plan included two. The Katerma turbine has a maximum capacity of 10 MW.

The facility was refurbished in 2001 and is currently owned by UPM Energy. Pitkänen also designed the small residential area for the power plants workers on the shore of the headrace. This area has three wooden single-family type houses and a service building.

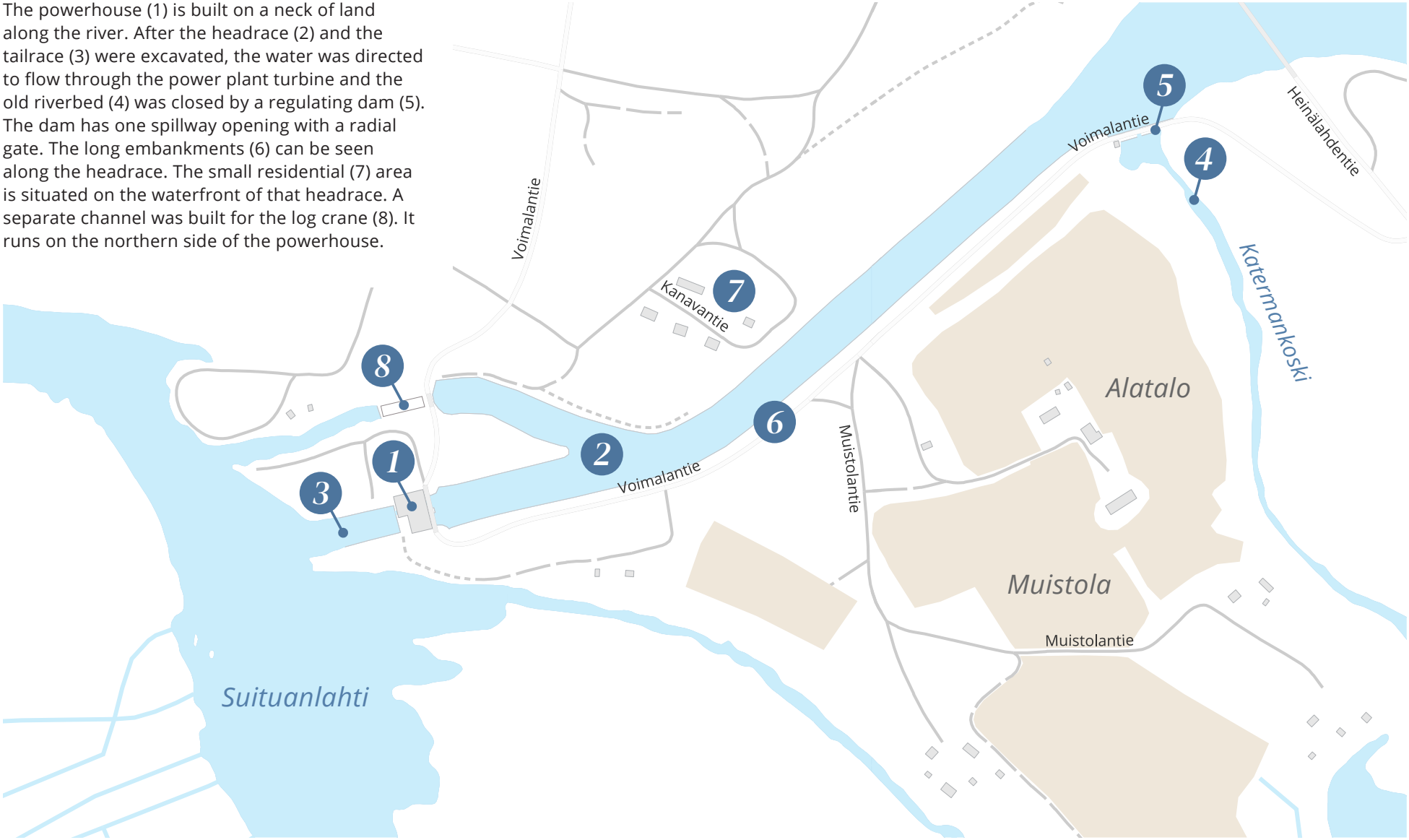
*The Katerma power plant as seen from above the headrace. Photo: MOK*

## Location


*Katerma is located in the municipality of Kuhmo in the Kainuu Region. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement

The powerhouse (1) is built on a neck of land along the river. After the headrace (2) and the tailrace (3) were excavated, the water was directed to flow through the power plant turbine and the old riverbed (4) was closed by a regulating dam (5). The dam has one spillway opening with a radial gate. The long embankments (6) can be seen along the headrace. The small residential (7) area is situated on the waterfront of that headrace. A separate channel was built for the log crane (8). It runs on the northern side of the powerhouse.




*The site plan of Katerma. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

*Katerma as seen from above. The old riverbed is visible on the right. Photo: MOK © MOK*

## Architecture

Pitkänen based his powerhouse design on functionalism. However, the end result reflects several of his compromises, such as the gable roof, vertically placed window openings, and the use of slate in the façades all create a vernacular and display classicist undertones.

The building has an on-site cast concrete frame and plastered brick cladding. The main mass consists of two blocks. The larger block contains the machine hall and the gate hall, while the more articulated and detailed smaller block contains the offices and control rooms.

Katerma's speciality is the log chute that runs right through the powerhouse.

*The machine hall of Katerma powerhouse has machinery. Photo: Pekka Elomaa © Council of Oulu Region.*

## Residential area

Katerma has a small residential area that was constructed on the waterfront of the headrace. This area was designed by Eino Pitkänen and built in the late 1940s.

The area consists of:
Three detached single-family houses (1)
Service building (2)
Sauna (3)

The houses are type houses but for these, Pitkänen used different house types from those he designed in Kallioinen or Leppikoski.


*The residential area of Katerma. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

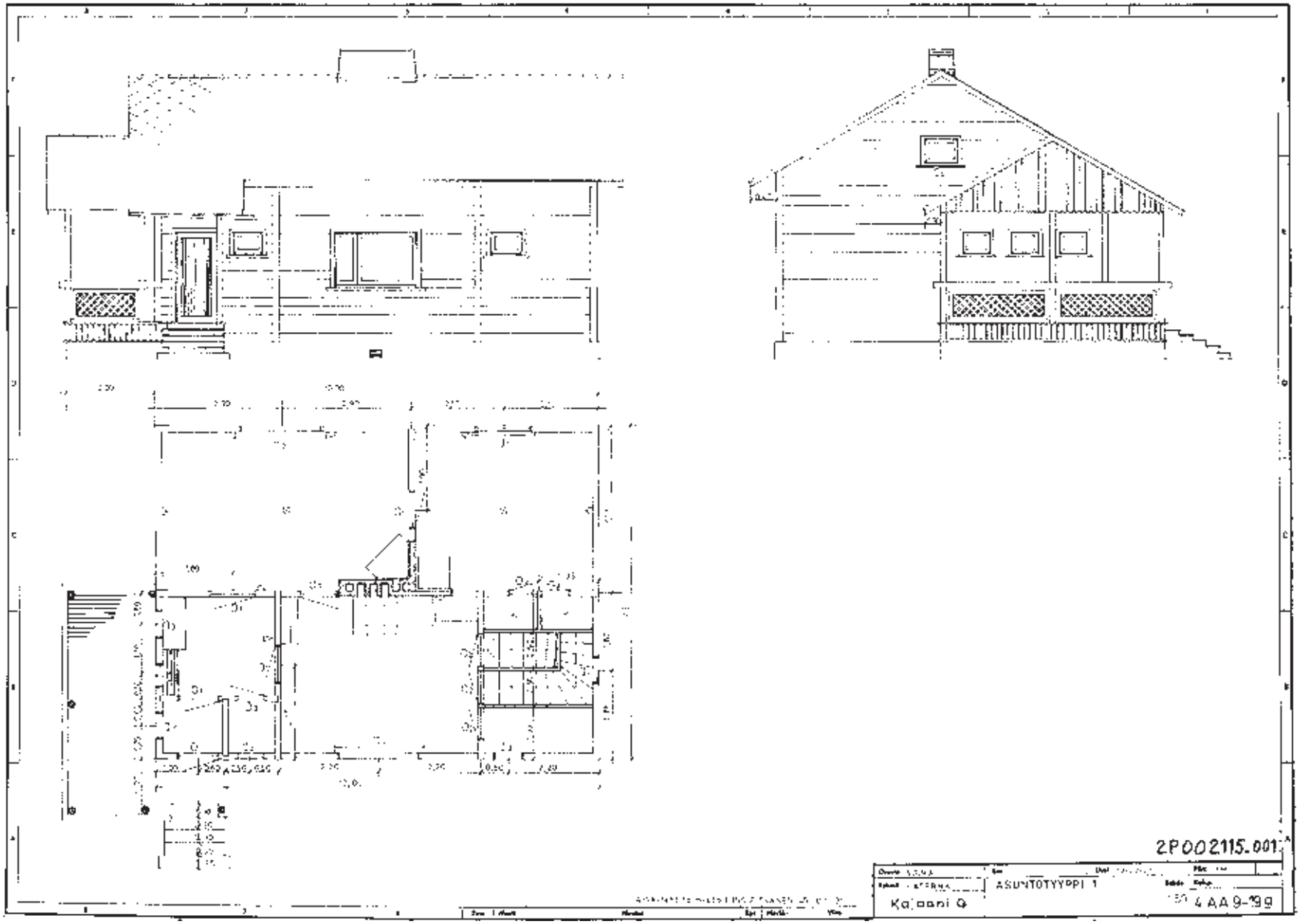
*The service building of Katerma has storage spaces and a sauna. Photo: Pekka Elomaa © Council of Oulu Region.*

*The residential area of Katerma. The houses are typical of the post-war era in Finland. Photo: Pekka Elomaa © Council of Oulu Region.*

The single-family type houses designed by Pitkänen in Katerma are typical of the post-war era in Finland. These balloon framed and board cladded houses have a programme that is formulated around the hearth on two floors. The houses have tile roofs.

The open porch is also a typical feature of the houses of the era. The living room windows look out on the water. The houses are placed in a line along the road that circles the area, while the service building is placed at the centre of the plan.

Overall, the milieu is well thought out and the houses sit naturally in the landscape.




*Pitkänen, single-family type house of Katerma, northeast and southeast elevations and ground plan. © UPM Energy.*

# 5.2.4 Kallioinen

*The most conspicuous element of Kallioinen is the long concrete structure for the log crane. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Kajaani Ltd.
**Owner:** UPM Energy
**Built:** 1955–1957
**Architectural design:** Eino Pitkänen, architect
**Machinery:** One Kaplan turbine with vertical axis
**Capacity:** 13,9 MW
**Head**: 9 m
**Powerhouse:** In-situ concrete frame, plastered brick facades
**Dams:** Earth dams and embankments. A small concrete regulating dam with one spillway opening in the old riverbed.
**Special features:** Large concrete structure for the log crane
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Regional plan

Kallioinen is a small hydropower plant located on the River Ontojoki that flows from the eastern border of Finland westwards towards Lake Oulujärvi. The power plant was built by Kajaani Ltd. between 1955 and 1957.

There are two hydroelectric power plants on the River Ontojoki, Katerma and Kallioinen. Kallioinen is located downstream from Katerma in the municipality of Sotkamo.

The design process was initiated by Eino Pitkänen, one of Kainuu regions most important modernist architects who was known for his functionalist works. After he passed away, an engineer, Jaakko Asikainen, continued Pitkänen's work, staying true to Pitkänen's vision.[1] Kallioinen was refurbished in 2001 and is now owned by UPM Energy.

The power plant has one Finnish manufactured Kaplan turbine that produces 13.5 MW of power.[2] Pitkänen also designed the small residential area for the power plant workers. This area is located on the waterfront and has four wooden single-family type houses.

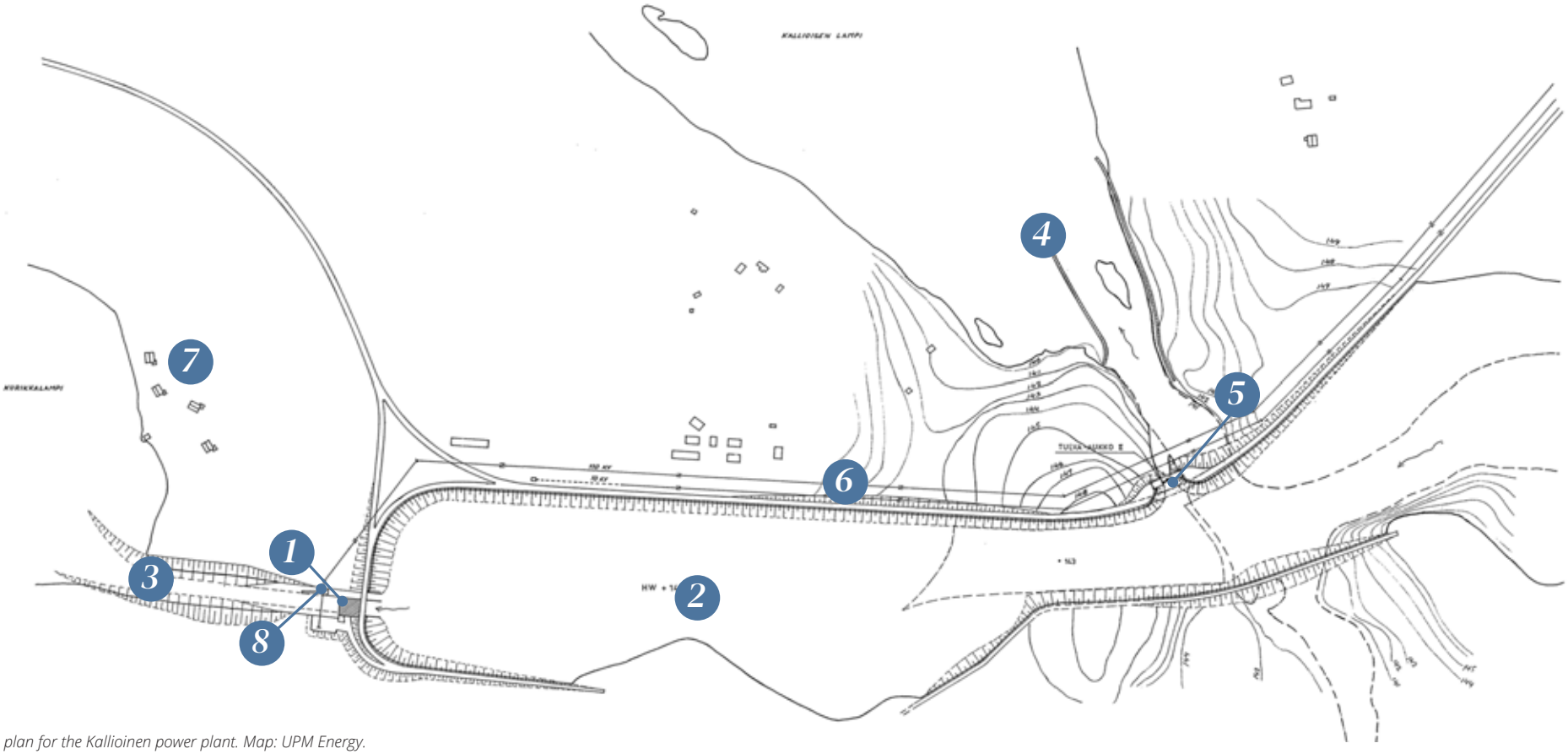
*1 Huhmo 2017, 87*

*2 Ibid, 87*

*Aerial photo of the Kallioinen power plant and the forebay. Photo: MOK © MOK.*

## Location


*Kallioinen is located in the municipality of Sotkamo in the Kainuu Region. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*




*Site plan for the Kallioinen power plant. Map: UPM Energy.*

## Functional arrangement

The powerhouse (1) is built on a neck of land that once separated the River Ontojoki and Kiikarilampi pond. After the forebay (2) and tailrace (3) were excavated, the water was directed to flow through the power plant's turbine and the old riverbed (4) was closed by a small regulating dam (5).

The dam has one spillway opening with a sluice gate. The long embankment (6) is visible on the northern bank of the forebay. The small residential (7) area is built on the shore of the pond. The log crane (8) is located on the northern side of the power house.

*An aerial photo of Kallioinen. Photo: MOK © MOK.*

## Architecture

The powerhouse of Kallioinen has an in-situ cast concrete frame with plastered brick façades and a gable roof. The architecture can be described as a rural application of functionalism with certain classicist and regionalist undertones.

The powerhouse is constructed around the machine hall that sits at the centre. The gate hall is located on the eastern side and the office block on the western side.

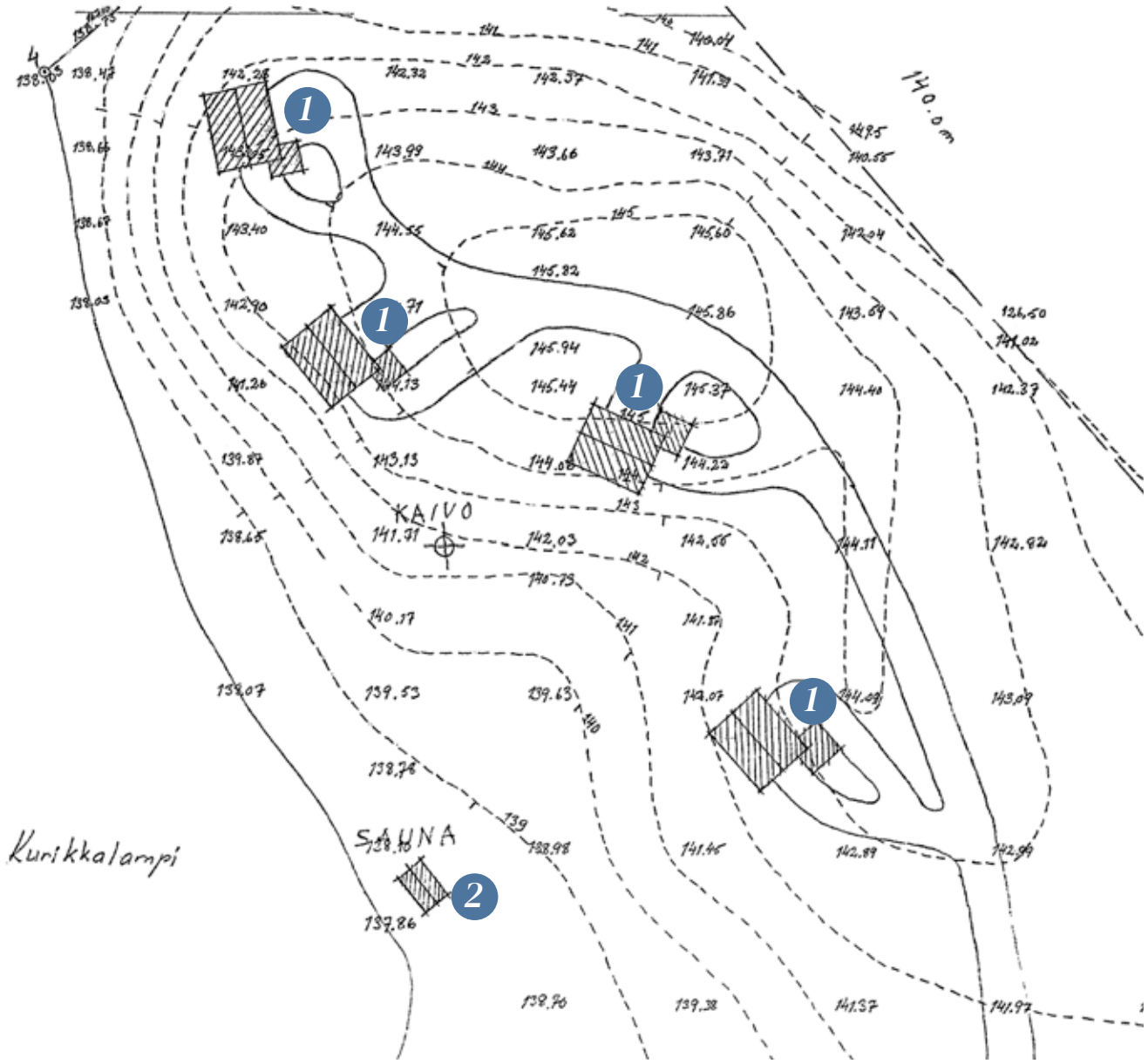
The simple cube-like mass of the powerhouse is placed at the centre of the plan, in between the log crane and the switchyard. The most conspicuous element of the facility is the elongated concrete structure of the log crane.

Other noteworthy features are the long embankments along the forebay. The small concrete regulating dam is built in the old riverbed, which is upstream from the power plant.

*Kallioinen has one machinery. Photo: Pekka Elomaa © Council of Oulu Region.*

## Residential area

Kallioinen has a small residential area that is located about 300 metres northwest from the power plant. The area consists of four detached single-family houses (1). The area also has a communal sauna (2) at the shore of the pond. The houses are placed on the top of a gently sloping ridge with a beautiful view to the pond. The area was designed by the architect Eino Pitkänen and built in the mid-1950s.




*Pitkänen, Kallioinen residential area, site plan. © UPM Energy.*

*The residential area of Kallioinen was built in the mid 1950s. Photo: Pekka Elomaa © Council of Oulu Region.*

Pitkänen's houses in Kallioinen have an architectural language that is rather typical of the post-war era single-family houses in Finland. The houses in Kallioinen are modernist in their appearance, programme and overall concept and they incorporate some of the more common features of the era.

These include the concrete foundation that is cladded with slate as well as the featherboard clad balloon frame. Another modern feature is the garage that was built into the basement of every house, although cars were rather rare in rural Finland in the 1950s.

Some of the houses have retained the original tile roofs but some roofs have been renewed.

# 5.2.5 Koivukoski III

*Koivukoski III. Photo: Pekka Elomaa © Council of Oulu Region.*

Koivukoski III is a hydropower plant that is located in the River Kajaaninjoki area. It is also known as the River Kajaaninjoki Tunnel Power Plant, because a part of the power plant processes take place in a tunnel created under the Kajaani city centre. The powerhouse is located in Petäisenniska Industry Park. The outlet of the tunnel is located in the vicinity of the ruins of the medieval Kajaani Castle.

### Technical information

**Power plant type:** Run-of-river, tunnel plant
**Contractor**: Kainuu Power Company
**Owner:** Kainuu Power Company
**Finished:** 1995
**Machinery:** One Kaplan turbine with vertical axis
**Capacity:** 20 MW
**Head**: 15–17 m
**Powerhouse:** In-situ concrete frame, brick facades
**Special features:** The tunnel runs under donwtown Kajaani
**Zoning status**: Detailed plan

## Location


*Koivukoski III is located in city centre of Kajaani in the Kainuu region. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

# 5.3 Hyrynsalmi Route

After the power plants on the River Oulujoki were finished in 1957, the Oulujoki Power Company moved its resources north to the River Emäjoki that flows from Lake Kiantajärvi southwest to Lake Oulujärvi. The River Emäjoki is one of the most significant headwaters of Lake Oulujärvi and thus is an essential part in the plan to harness the whole waterway. The Oulujoki Power Company began building its first power plant, Ämmä, in the city centre of Suomussalmi municipality in 1957.

The River Emäjoki has three power plants built by the Oulujoki Power Company: Ämmä, Aittokoski and Seitenoikea. The architectural design for these power plants was again created by Aarne Ervi and his office while Ilkka Paaja was responsible for the structural design. The Leppikoski power plant was originally built by Kajaani Ltd. But was bought by Oulujoki Power Company in 1962, a year before the plant was completed. Leppikoski was designed by Reino Laaksonen, M.Sc. (Eng) The Small Pyhännänkoski power plant, built by Kainuu Municipalities Electricity Ltd., is located on a tributary of the River Emäjoki.

The whole river was harnessed with these five power plants during a period between 1957 and 1963. This marked the end of the twenty-year construction project of the Oulujoki power company.

**This chapter includes:**

# 5.3.1 Pyhännänkoski

*The powerhouse of Pyhännänkoski. The sluice gate of the regulating dam can be seen in the back. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Kainuu Municipalities Electricity Ltd.
**Owner:** Eko-Sähkö Oy
**Finished:** 1957
**Architectural design:** Matti Kallio-Koski, M. Sc. (Eng)
**Capacity:** 3 MW
**Head**: 15 m
**Powerhouse:** Brick
**Dams:** Concrete regulating dam with one spillway that has a sluice gate
**Special features:** EKO-power plant, penstock runs underground

After the Second World War, questions concerning the production and distribution of electricity became pressing in Kainuu. In the early 1950s, the rapids of Pyhännänkoski were recognised as a suitable location for a hydropower plant. It is located on the River Kiehimänjoki, which is a branch of the River Emäjoki, located on the east side of the main channel. The Power plant was built by Kainuun Kuntain Sähköosakeyhtiö (Kainuu Municipa- lities Electricity Ltd.) The power plant was completed in 1957.[1]

The western branch of the channel has been dammed with a long embankment and currently functions as a headrace for the plant. The headwater has two regulating dams equipped with sluice gates. The gate near Lake Isopyhäntäjärvi regulates the water that flows into the headrace but also regulates the lake. The small powerhouse designed by Matti Kallio-Koski (M. Sc. Eng.) was constructed out of brick and finished in1957.

Although Pyhännänkoski is not located in the main channel of the River Emäjoki, it is a part of the series of hydropower plants built on the waterways of the Oulujoki River.

*1 http://www.kainuunnuotta.net/fi/koskenkyla/pyhannankosken-voimalaitos/*

# 5.3.2 Ämmä

*Powerhouse and switchyard of Ämmä. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Impoundment
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1957-1959
**Architectural design:** Aarne Ervi, architect
**Structural design:** Ilkka Paaja
**Machinery:** One Kaplan turbine with a vertical axis
**Capacity:** 16 MW
**Head**: 9.21–3.5 m
**Flow**: 110 $m^3/s$
**Powerhouse:** On-site casted concrete frame, cladded with precast concrete panels and sheet metal.
**Dams:** Concrete regulating dam with a moraine core. One spillway opening with a radial gate.
**Special features:** Located in downtown of Suomussalmi
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Detailed plan

Ämmä was not only the first power plant built on the River Emäjoki, but was also the first plant on the river that flows from Lake Kiantajärvi south to Lake Oulujärvi. As a consequence, Ämmä regulates the lake. The construction began in 1957 by building the service buildings, concrete mixing plants and housing in the area. The construction of the powerhouse, foundations for the dam as well as the excavations for the headrace and tailrace began in the same year.[1]

The construction of the concrete-framed powerhouse advanced quickly, as did all the other concrete works. As a result, water could be released to the headrace at the end of the year in 1958. At the same time, the other branch of the river, the Jalonhaara, was closed by an embankment.

The power plants on the Emäjoki – Ämmä, Seitenoikea and Aittokoski – were built in series and this enabled the workforce and machines to move from one site to another as soon as the different stages were finished. Ämmä hydroelectric plant was finished in 1959 and the machinery connected to the power grid on 14 November 1959.[2]

*1 Kuuskoski 1991, 49-50*

*2 Ibid 50*

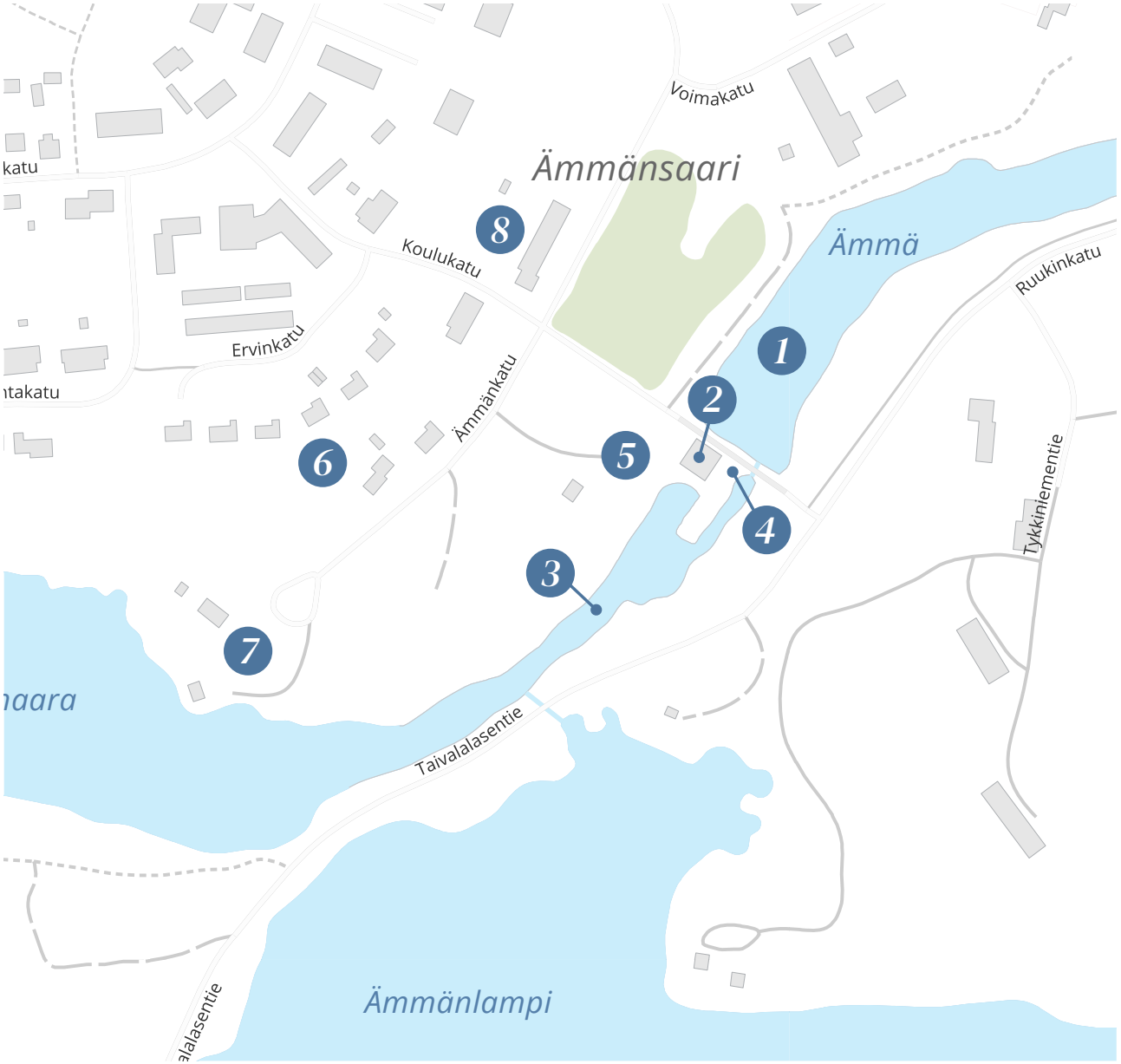
*Concrete structure of the log crane is the most striking feature of Ämmä. Photo: Pekka Elomaa © Council of Oulu Region.*

## Location


*Ämmä is located in the city centre of Suomussalmi near Lake Kiantajärvi. The River Emäjoki flows from Lake Kiantajärvi southwest to Lake Oulujärvi.*
*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

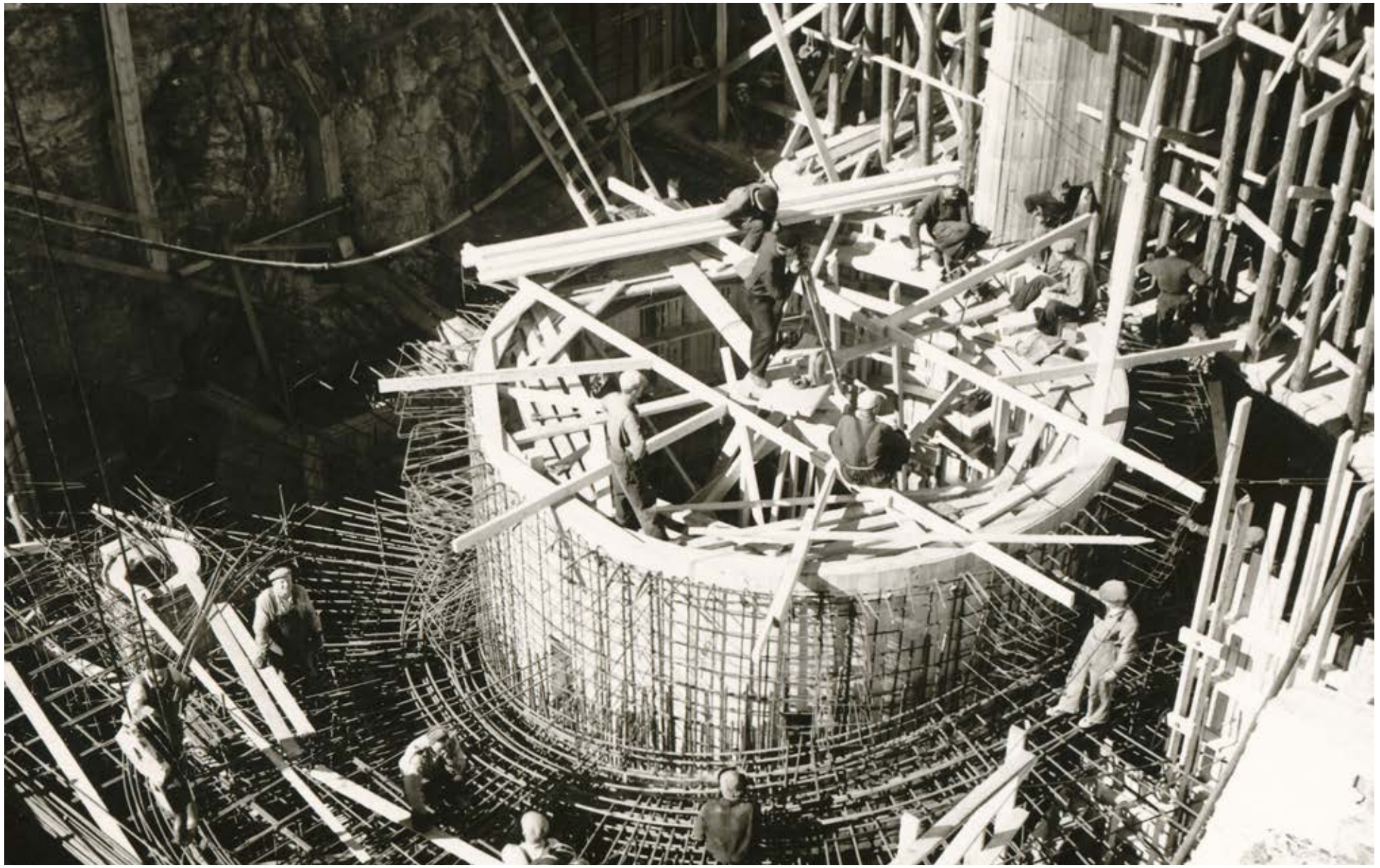
## Functional arrangement

Water flows from the headrace (1) into the powerhouse's (2) turbine through the intake gaps and the water is then released into the tailrace (3). The regulating dam and the log crane (4) are built on the easter side of the powerhouse. The dam has one spillway gap with a radial gate. The switchyard (5) is located on the western shore of the canal. The medium-sized residential area (6) is located on the western side of the powerhouse and the guesthouse (7) is situated at the end of Ämmänkatu road. The small service area (8) is also built next to the residential area.




*Site map of Ämmä. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*


*The Ämmä powerhouse under construction during the winter months of 1959. Photo: Foto Roos © Fortum Power and Heat.*



*The turbine structures of Ämmä powerhouse are being cast. Photo: Foto Roos © Fortum Power and Heat.*

## Architecture

The three power plants built on the River Emäjoki, Ämmä, Aittokoski and Seitenoikea, share certain similarities. This is clearly apparent in Ämmä's architecture and in the disposition of the entire area. Ämmä, like all power plants on the River Emäjoki, has only one turbine. This leads to a simple cube–like mass for the powerhouse that is mined deeply into the bedrock so that the building is almost indistinguishable from the headrace.

The small powerhouse was built on dry land and the headrace and the tailrace were mined through a neck of land in the city centre of Suomussalmi. The regulating dam was constructed on the eastern side of the powerhouse. The frame was cast out of concrete on site and cladded with fibre-reinforced cement board. When composing the façade, Ervi showcased less thorough work. This is evident in the seams on the cement boards that do not line up from façade to façade.

The organisation of the powerhouse is simple. While the machine hall is the largest space in the building, the entire façade that faces the tailrace consists of offices. The ribbon windows of the office façade also draw light into the building. The butterfly roof is supported by steel grids.

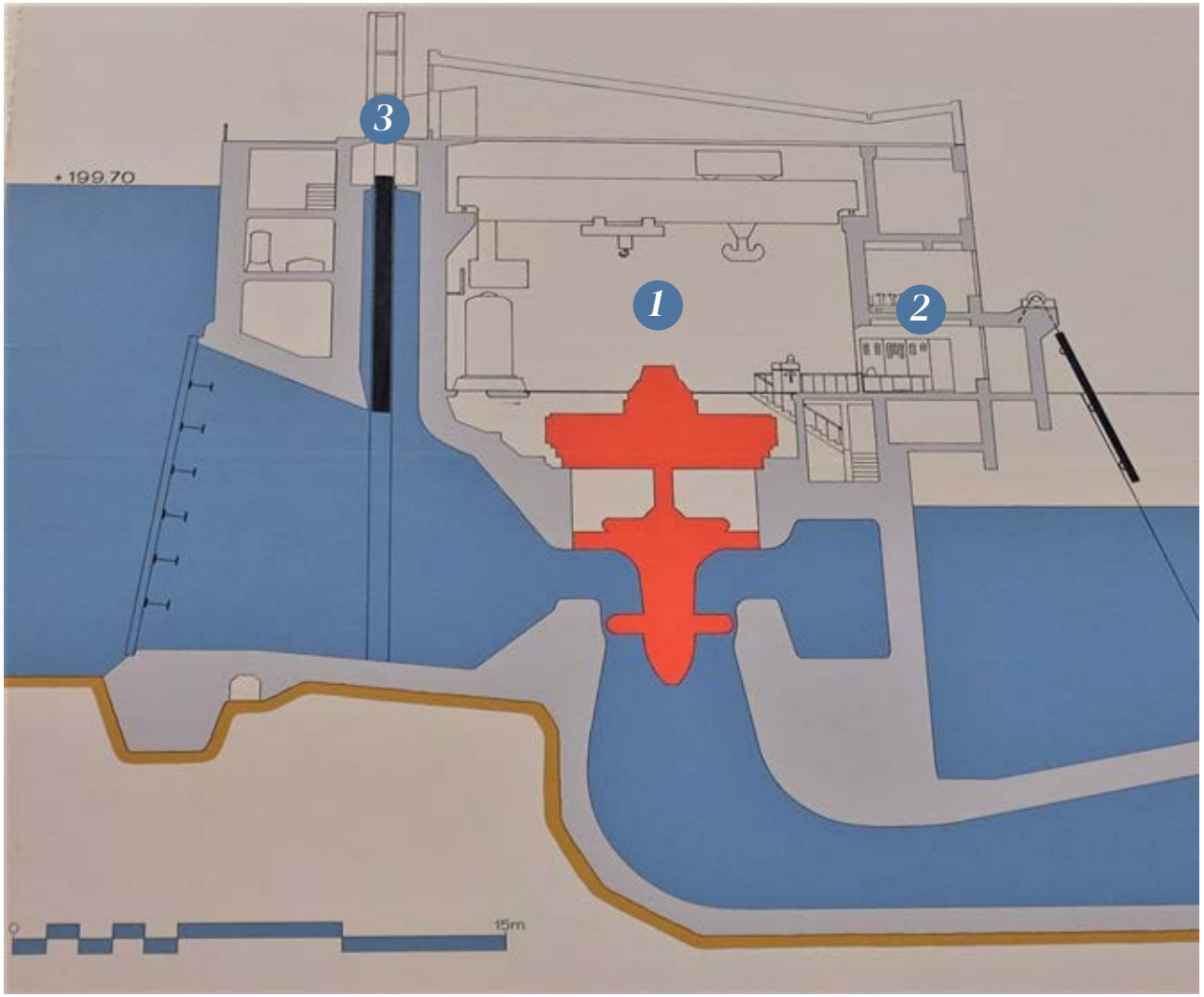
A temporary wooden log chute was also constructed but dismantled soon after the large concrete log crane was built in 1963. The girder structure of the crane is now the most significant feature in the appearance of the building.

*The most striking feature of Ämmä is the concrete structure of the log crane, as seen here from the tailrace. Photo: Pekka Elomaa © Council of Oulu*

*Concrete stairs on the retaining wall. Photo: Pekka Elomaa © Council of Oulu Region.*

Ämmä powerhouse has a simple organisation in that the different functions are placed around the large machine hall (1). The offices and control rooms (2) are placed on the side of the tailrace on a block that is separated from the machine hall by a concrete wall. The wall also supports this section of the building.

Like Utanen, Ämmä does not have a separate gate hall and the control gate is placed (3) in a narrow bay between the building and the dam bridge.




*Ervi, a section of the Ämmä powerhouse. © Fortum Power and Heat.*

## Residential area

Ämmä has a medium-sized residential area that is located in the city centre of Suomussalmi municipality. The area was built at the end of 1950s and is designed by Aarne Ervi and his office. The area has eight wooden single-family houses.

The area consist of:

8 detached single family houses (1)
Guesthouse (2)
Service building (3)
Sevice/office building for the power plant (4)

Here Ervi used the same house types as in Pyhäkoski and Seitenoikea. The house types are A1 (houses 12, 10 and 13) and a smaller version B1 (houses 8, 6, 4 and 2). The area also has one house built in the 2000s (house 15). A guesthouse with a waterfront sauna was built for the area in the 1950s. It now functions as a single-family house.

Garages were built on the plots in the 2000s. The garages follow Ervi's original architectural language and fit nicely into the area. A small maintenance area for the power plant was constructed on the other side of Koulukatu road. The maintenance area has one service/office building.

The houses are situated along two roads on a ridge that slopes gently towards the power plants tailrace. The area is well planned and the houses form a picturesque wooden "village" that is situated inside a larger city.


*The residential area of Ämmä. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

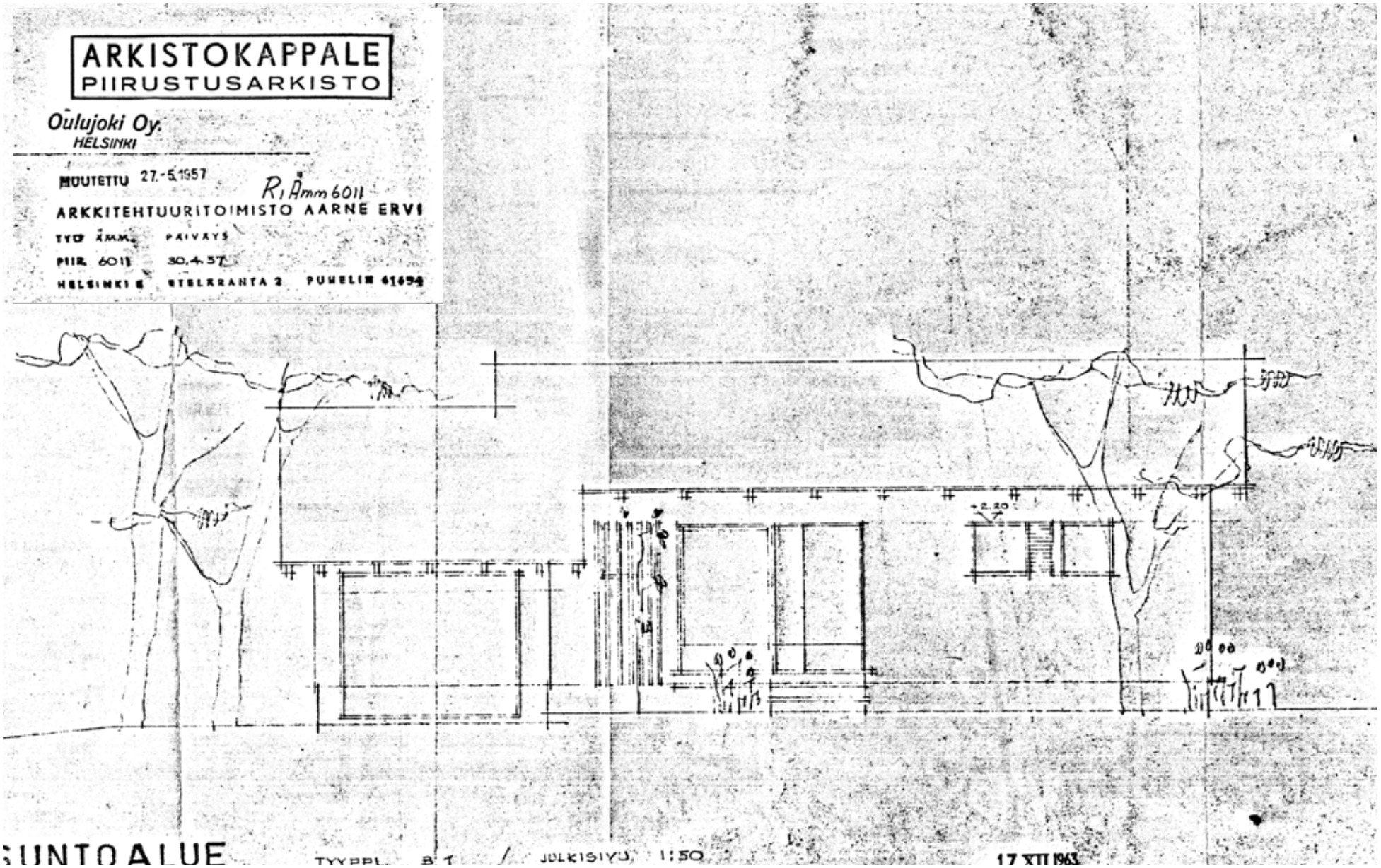
*Ämmä residential area in 1959 after completion. Photo: Foto Roos © Council of Oulu Region.*

*A single family house (house type B1) in Ämmä. Photo: Pekka Elomaa © Council of Oulu Region.*

Four out of eight of the single-family houses in Ämmä are the smaller B1 house type. This two-bedroom house has one living floor and an unheated basement. One bedroom is situated above the garage but other than that, the attic is not in use.

The building has a concrete foundation, wooden balloon frame with board and batten cladding and a tile roof. Each house currently also has an additional garage/storage that was constructed in the 2000s.

Additional insulation has been added later to the exterior walls and to the foundation. This has altered the appearance of the house slightly. The large window next to the door has also been replaced by a smaller one. However, in general, the area has retained its original park-like serenity and splendour.

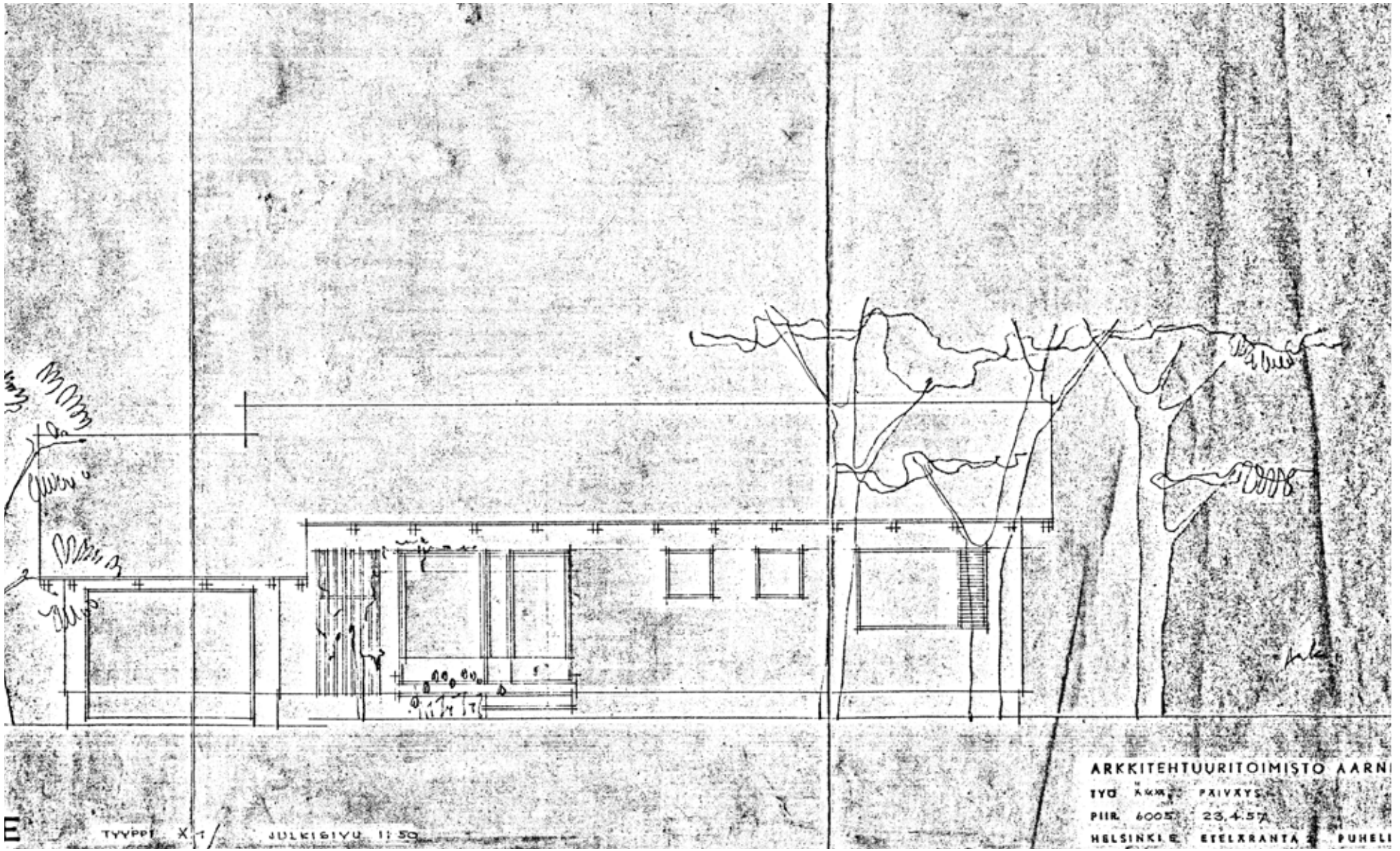



*Ervi, house type B1, Ämmä residential area, north elevation. © Fortum Power and Heat.*

*House type A1 in the Ämmä residential area. Photo: Pekka Elomaa © Council of Oulu Region.*

*The type A1 house in the Ämmä residential area. Photo: Pekka Elomaa © Council of Oulu Region.*

Ämmä has three larger type A1 houses. These are similar to those of type B1 except that type A1 houses are equipped with three bedrooms.



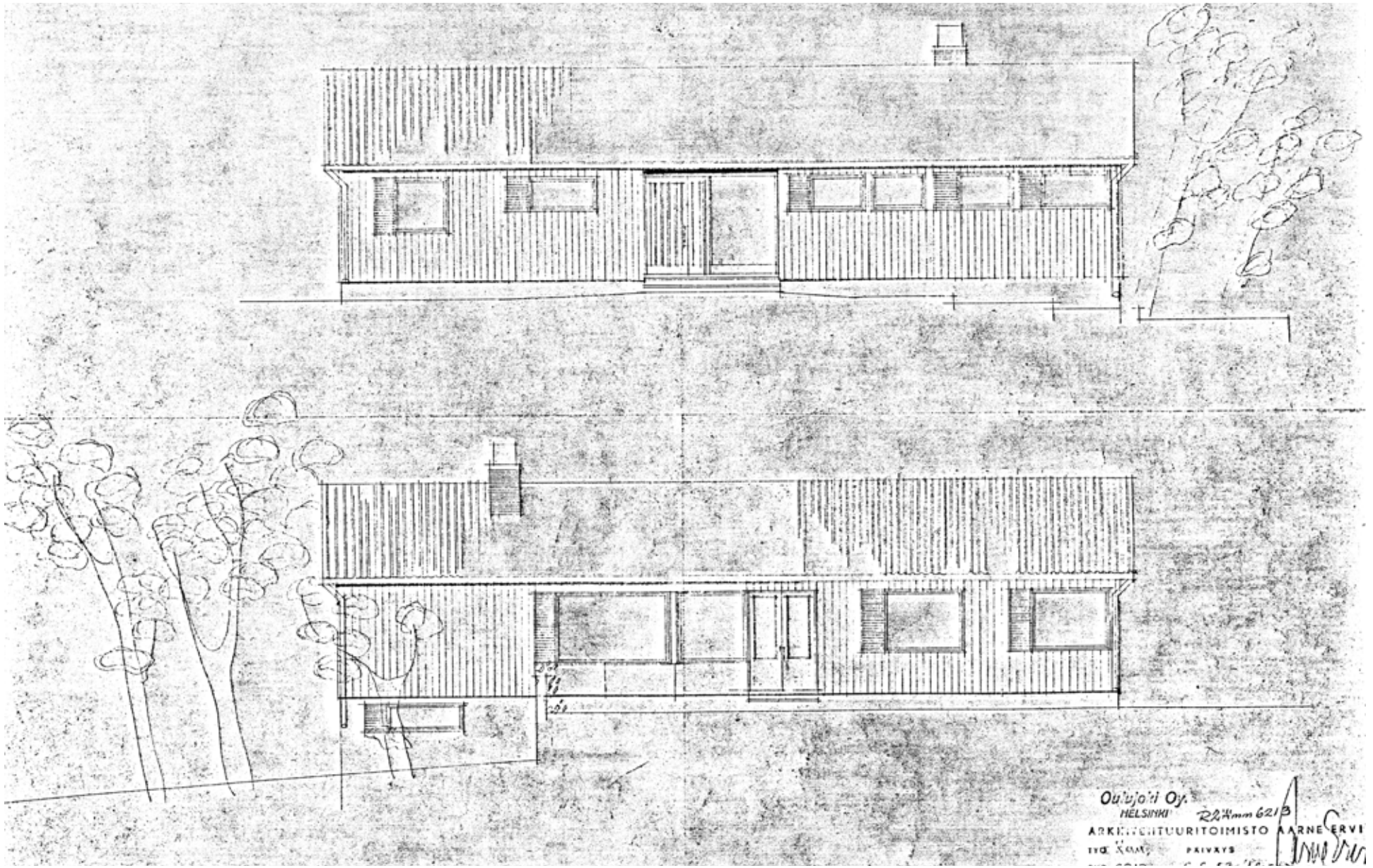

*Ervi, house type A1, Ämmä residential area, north elevation. © Fortum Power and Heat.*

*The Ämmä guesthouse has been converted into a large single-family house. Photo: Pekka Elomaa © Council of Oulu Region.*

The guesthouse in Ämmä is located on a gently sloping plot at the waterfront and was built to house the guests of the Oulujoki Power Company. The simple design features Ervi's hallmark features and materials.The guesthouse has a concrete foundation, a wooden frame with board and batten cladding as well as tile roofing.

The building has two floors and the ground floor is built as a substructure and is not visible from the driveway. The ground floor also has a garage. In Ervi's original drawings, the house is referred to as the "Guesthouse/Engineer's house", which means that his original idea was that the building would also function as a single-family house.

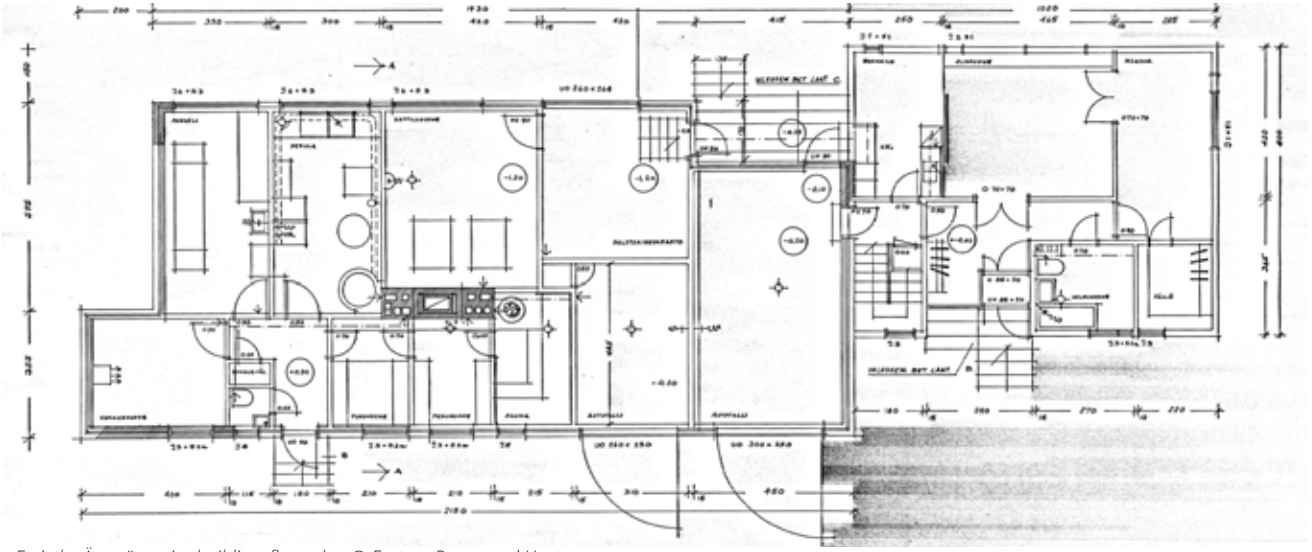
An additional garage was built on the plot in the 1990s. The complex also has a sauna that is situated by the water.




*Ervi, the Ämmä guesthouse, northeast and southwest elevations. © Fortum Power and Heat.*

The service building in Ämmä is located on the edge of the area along Koulukatu road. It is very similar to Ervi's other service buildings that are located along the rivers. This particular service building has a concrete foundation and a lightweight concrete block frame that has been plastered. The apartment section has a board and batten cladding. The building features several functions. For example, it has a boiler room, a fuel storage space, a clothes washing room, a mangle room, a sauna and a garage. The building also has a one-bedroom apartment for the caretaker and an unheated basement storage. The chimney of the boiler remains today. The tile roofing has been redesigned to resemble the original.

*The Ämmä service building Photo Pekka Elomaa © Council of Oulu Region.*



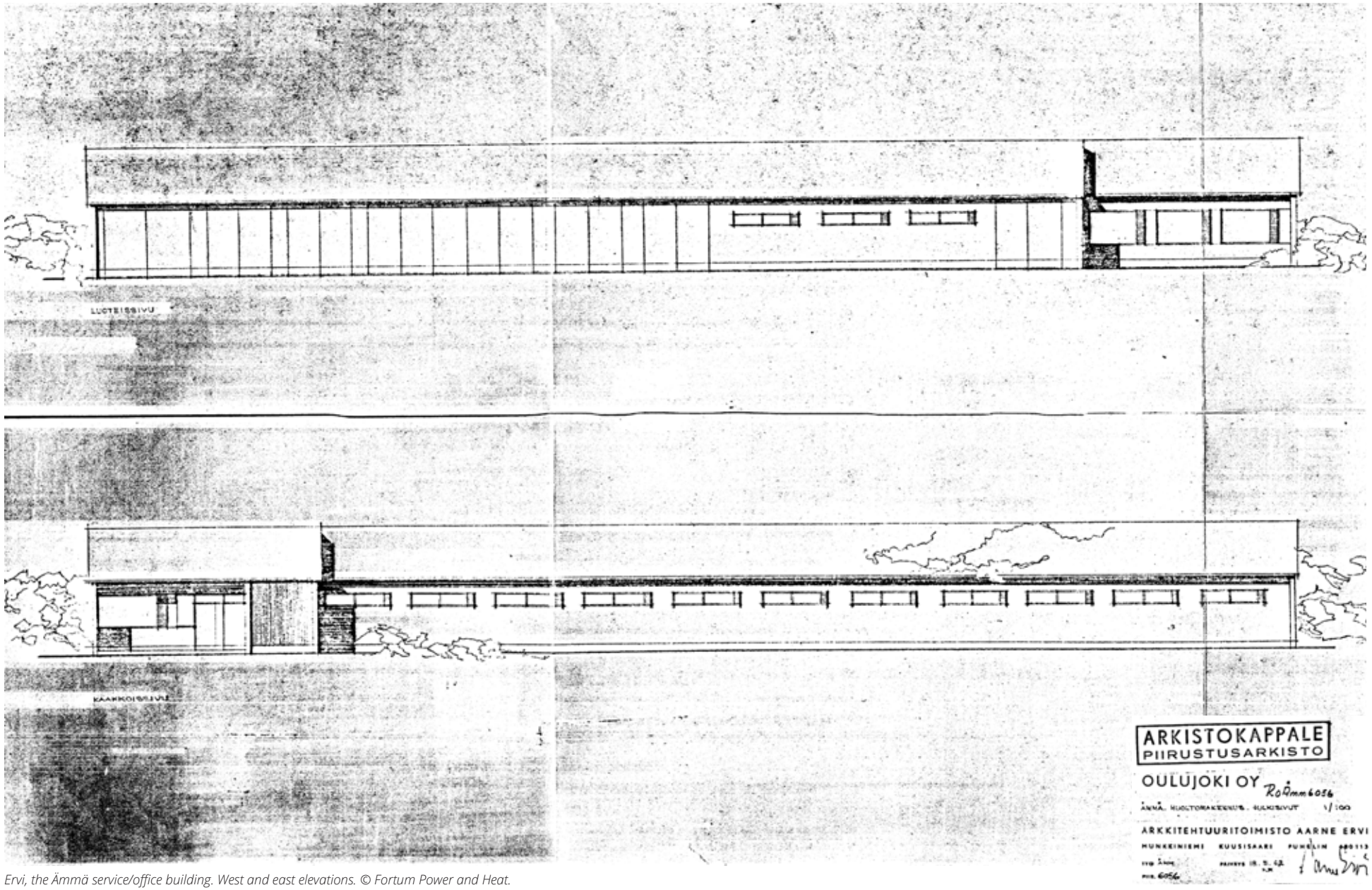
*Ervi, the Ämmä service building, floor plan © Fortum Power and Heat.*

*The Ämmä service building Photo Pekka Elomaa © Council of Oulu Region.*

*The service/office building in the service area. Photo: Samuli Paitsola © Council of Oulu Region.*

The small service area for the power plant is located next to the residential area and it has one service building with several garages. The building also has an office for administration.

This brick building has a concrete foundation and a tile roof. The building is still in use and in good condition.




*Ervi, the Ämmä service/office building. West and east elevations. © Fortum Power and Heat.*

# 5.3.3 Aittokoski

Aittokoski is located in the municipality of Suomussalmi in the Kainuu region. It was built soon after Ämmä. While sharing certain similarities, the challenging Aittokoski construction site in the middle of the wilderness differs greatly from the suburban vistas of Ämmä. The power plant was once again designed by Aarne Ervi and his office, while Ilkka Paaja was solely responsible for the hydropower aspects of the facility.

The construction of Aittokoski began early in 1958 and the extraction works had already been finished a year before. Due to the composition of the soil, as in Montta, the ICOS-Veder method had to be utilised to condense the ground under the earth dams. The concrete works of the power plant, the canals and the floodgate were almost completed by the end of 1958 and water could be funnelled through the floodgate. The dam and the rest of the concrete works were finished in 1959.

The forebay was filled during the spring flood of 1960.[1] Today, the large forebay dominates the view on the upper reaches as the long earth dam reaches several hundred metres on both sides of the powerhouse. The concrete log crane was built in 1963.

1 Kuuskoski 1991, 50

Aittokoski has only one set of machinery. The turbine was ordered from Tampella and the generator from Strömberg. As the trial run was performed without problems, Aittokoski was connected to the power grid on 16 June 1960. Due to the 30-metre head, Aittokoski's single turbine generates 35 MW of electricity, making it the largest hydropower plant on the River Emäjoki. Due to the large-scale earthmoving works and excavations, the landscaping and dredging continued for three years after the power plant was completed.[2]

2 Ibid

*The powerhouse of Aittokoski.*
*Photo: Pekka Elomaa © Council of Oulu Region.*

## Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1958–1960
**Architectural design:** Aarne Ervi, architect
**Structural design:** Ilkka Paaja
**Machinery:** One Kaplan turbine with vertical axis
**Capacity:** 35 MW
**Head**: 30 m
**Flow**: 150 m³/s

**Powerhouse:** In-situ concrete frame, cladded with profiled aluminium sheeting.
**Dams:** Concrete regulating dam with one spillway opening and radial gate. Large earth dam with moraine core.
**Special features:** Built in the middle of wilderness.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Regional plan

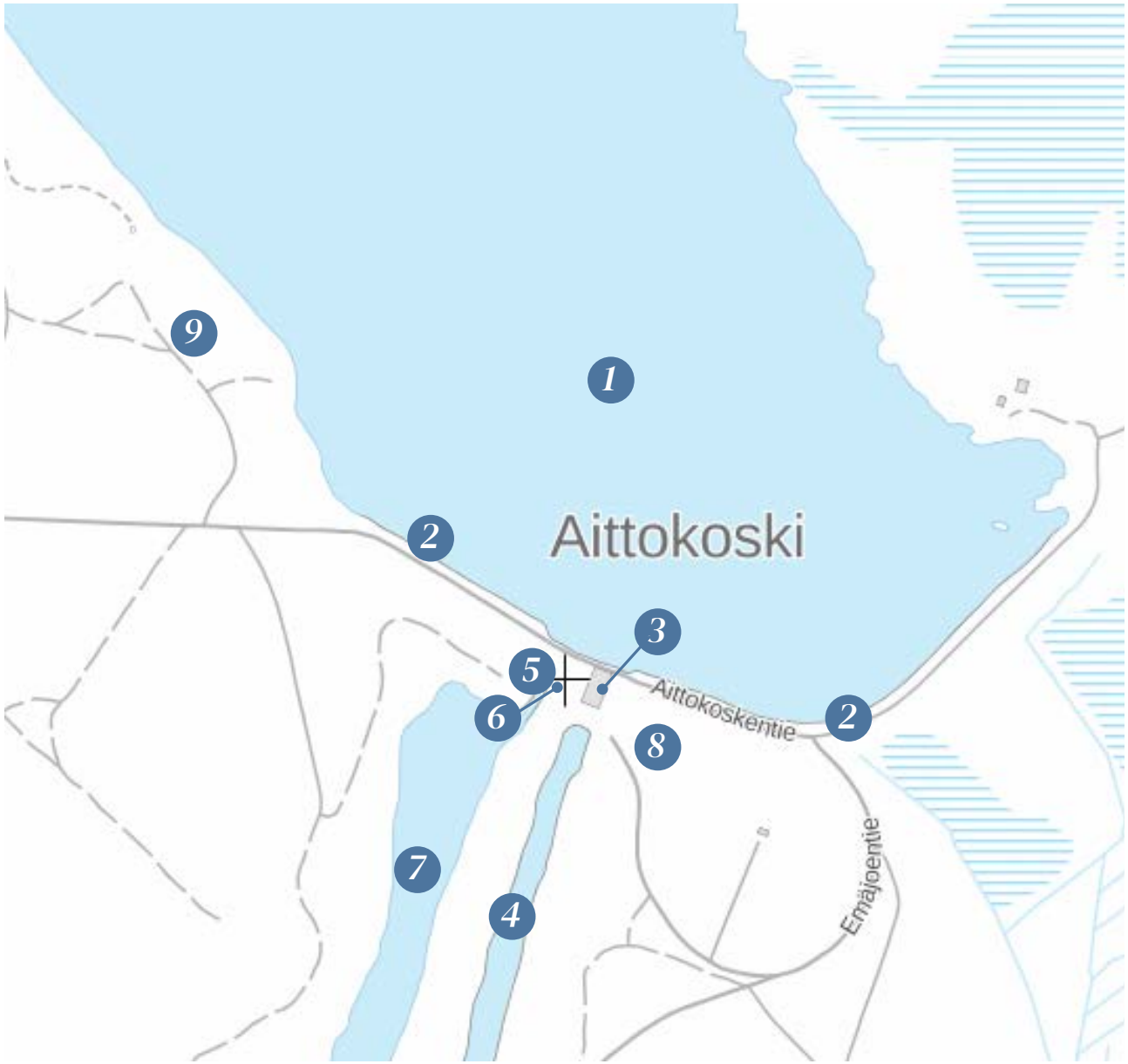

*The powerhouse of Aittokoski in 1960 seen from the dam bridge. Photo: Foto Roos © Fortum Power and Heat.*

## Location


*Aittokoski is located on the River Emäjoki in the municipality of Suomussalmi. The River Emäjoki flows from Lake Kiantajärvi towards the southwest to Lake Oulujärvi.*
*Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement

The forebay (1) is formed by large earth dams and embankments (2). Water is directed from the forebay to the turbine of the powerhouse (3) through the intake gaps and released into the excavated tailrace (4). The concrete regulating dam (5) is built on the western side of the powerhouse and has one spillway gap. The concrete-framed log crane (6) is situated between the powerhouse and the regulating dam. The overflow is released into the old riverbed (7). The switchyard (8) is located on the eastern side of the powerhouse. The small residential area (9) was demolished in the 1980s.




*Site map of Aittokoski. Map: National Land Survey of Finland.*


*The construction of the forebay required large-scale earth moving works and excavations. Photo: Foto Roos © Fortum Power and Heat.*

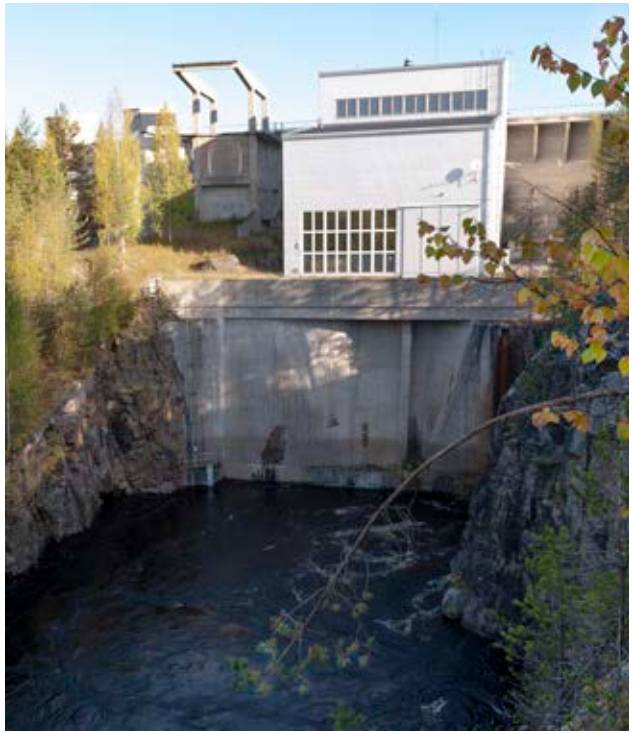

*The powerhouse and regulating dam of Aittokoski under construction in the autumn of 1959. Photo: Foto Roos © Fortum Power and Heat.*

## Architecture

The construction of the forebay required large-scale earth-moving works as over 6 million cubic metres of earth and 370 000 cubic metres of rock had to be excavated and moved during the construction process. The construction site also dictated the overall composition of the powerhouse.

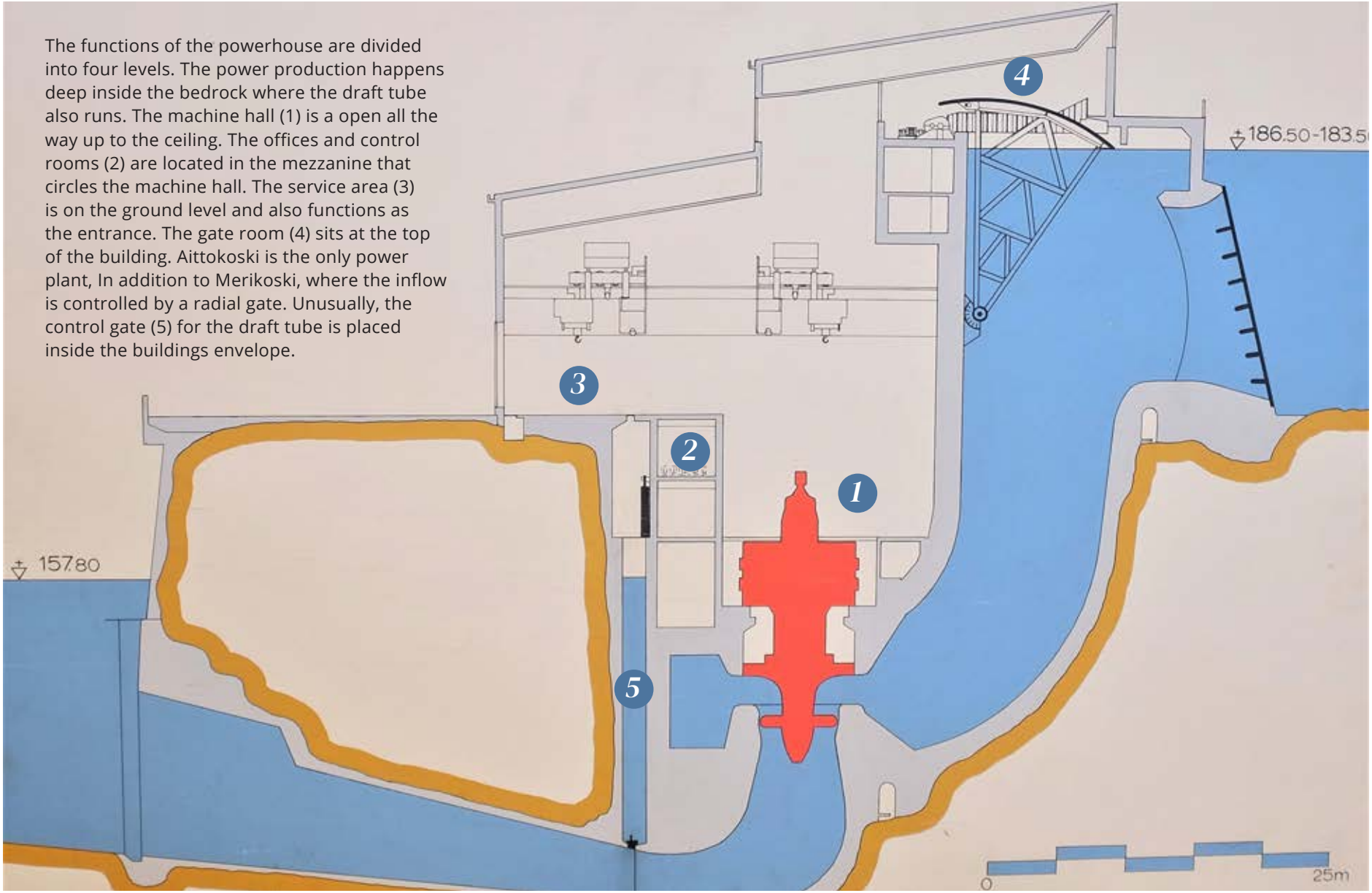
The Aittokoski powerhouse is built in a 30 metre-deep chasm inside the bedrock, which contributes to the building having a vertical, tower-like, shape and this also dictates its programme. Observing the building at ground level, one can only see the upper half of the structure because the lower half is mined into the bedrock. Aittokoski is also the only power plant that has a draft tube running completely underground. The tailrace is also completely excavated and runs in a rocky canyon parallel to the old riverbed. At present, the landscape is somewhat overgrown and the facility sits naturally in the woody scenery.

The concrete frame of the buildings was cast on site. Its profiled aluminium sheeting cladding and split-level roof with clerestory windows contribute to a drastically different appearance from Ervi's other powerhouses. The usual feature was, however, the large window surface of the entrance level that opens up towards the tailrace. An additional concrete-framed service space was built on the eastern side of the powerhouse, while the concrete-structured log crane and the regulating dam are located on the western side. The combination of aluminium and concrete gives the facility a striking and powerful industrial appearance. The verticality of the building can only be appreciated by viewing the building from the canyon where the tailrace runs. This perspective is dramatically different from the view from the forebay, where the whole facility is barely visible.

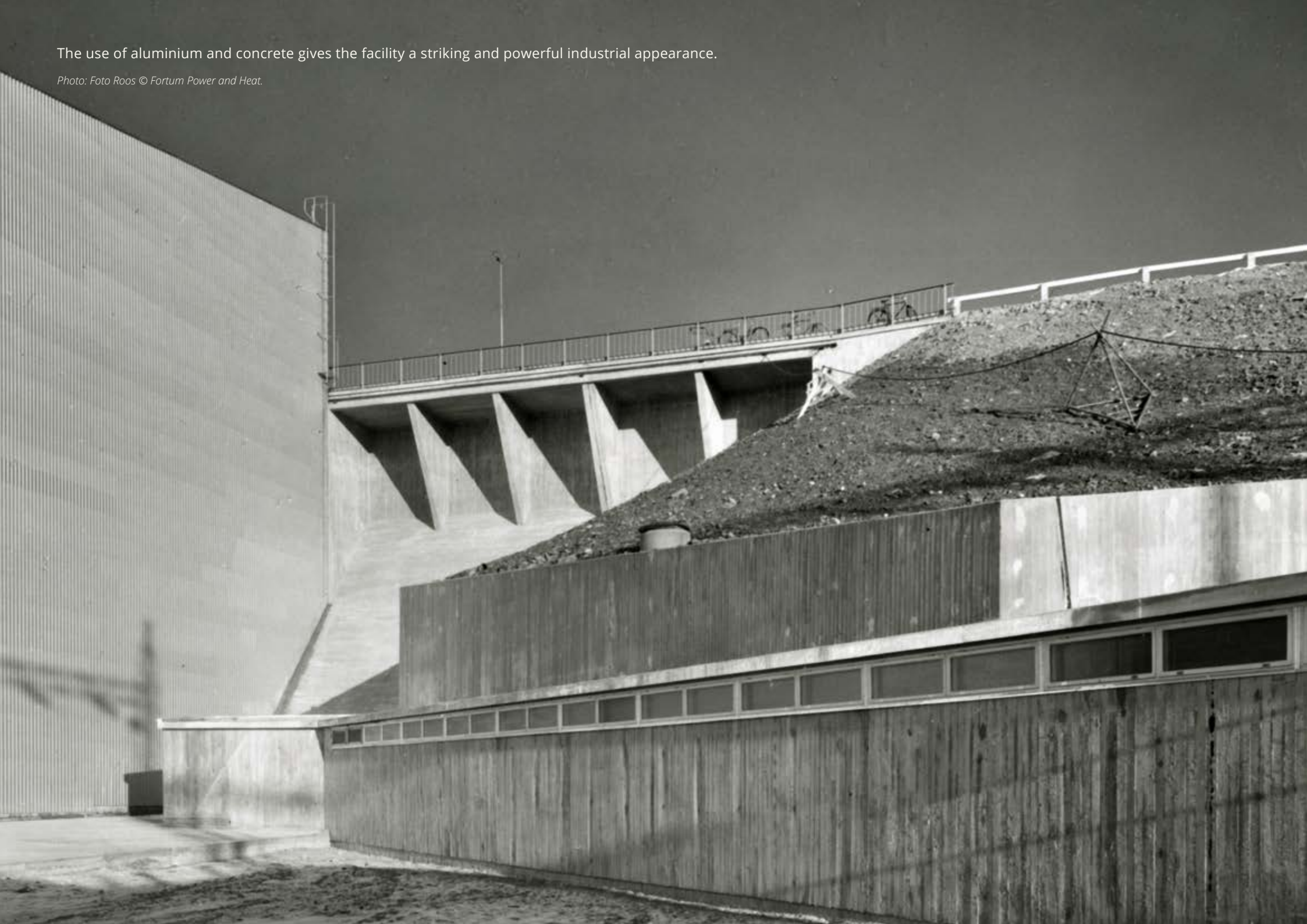


*Aittokoski as seen from the tailrace.*
*Photo: Pekka Elomaa © Council of Oulu Region.*

*The verticality of Aittokoski can really be sensed indoors.*
*Photo: Pekka Elomaa © Council of Oulu Region.*




*Ervi, a section of the Aittokoski powerhouse. © Fortum Power and Heat.*



The use of aluminium and concrete gives the facility a striking and powerful industrial appearance.

*Photo: Foto Roos © Fortum Power and Heat.*

*Opening ceremony of Aittokoski in June of 1960. The fact that President Kekkonen (sitting in front row in a tan suit) was present, tells a lot about the importance of the hydropower projects in Oulujoki waters. Photo: Foto Roos © Fortum Power and Heat.*

Despite the challenging and constricted building site, Ervi was able to bring natural light streaming into the building. Aittokoski is a masterclass on how to using the openness of the interior space, carefully placed windows and reflecting surfaces.

The programme is composed around the machine hall that is located on the bottom floor. The service level is built as a mezzanine that circles the machine hall bay. The spiral staircase lead up to the shallow gate room on the upper floor. The offices and control rooms are located in the mezzanine below the service level.

The appearance of the interior is dominated by the black and white striped clinker tile on the floor and the dramatic blue and yellow, while the generator is painted red. Ervi also refined the interior with structural details such as the corbels that support the beams above them.

*The small residential area of Aittokoski was demolished in the 1980s. Photo: Foto Roos © Fortum Power and Heat.*

## Residential area

Aittokoski had a small residential area built about half a kilometre northwest from the power plant to house the workers of the power plant and their families. The area had three detached single-family houses placed on the waterfront of the forebay.

The houses were the same type B1 house that Ervi built in Ämmä. The houses featured three bedrooms and a garage. The houses had a concrete foundations, balloon frames with board and batten claddings and tile roofs. According to current knowledge, the area had no service building.

The houses were demolished in the 1980s. The area is now used for outdoor activities and a lean-to shelter can be found on the location.

# 5.3.4 Seitenoikea

Seitenoikea was the third and last hydroelectric power plant that was built on the River Emäjoki by the Oulujoki Power Company. Aarne Ervi designed this facility and it was built in three years.

The construction of Seitenoikea began in late 1958. The preparatory works included the construction of temporary housing, service buildings and roads. The project began to move faster in 1959, after the workforce and machines became available from other construction sites. At the end of the year, water could be released through the floodgate. The machinery was ordered from Finnish companies; the turbine was from Tampella and the generator from Strömberg.[1]

The earth fill dams were completed during 1960 and water could be raised to the forebay in the spring of 1961. The forebay forms a large lake that was upstream of the power plant, so the trees and bushes were cut down from the area before the water was released to the bay. The concrete-framed powerhouse was built at the same time and the whole power plant was finished in the summer of 1961.

The machinery was connected to the power grid on 8 June 1961 with a total power of 38 MW. The dredging works continued for three additional years, which gave the power plant more head.[2]

## Technical information

**Power plant type:** Run-of-river
**Contractor**: Oulujoki Power Company
**Owner:** Fortum Power and Heat
**Built:** 1958–1961
**Architectural design:** Aarne Ervi, architect
**Structural design:** Ilkka Paaja
**Machinery:** One Kaplan turbine with vertical axis
**Capacity:** 38 MW
**Head**: 15,6 m
**Flow**: 160 $m^3/s$

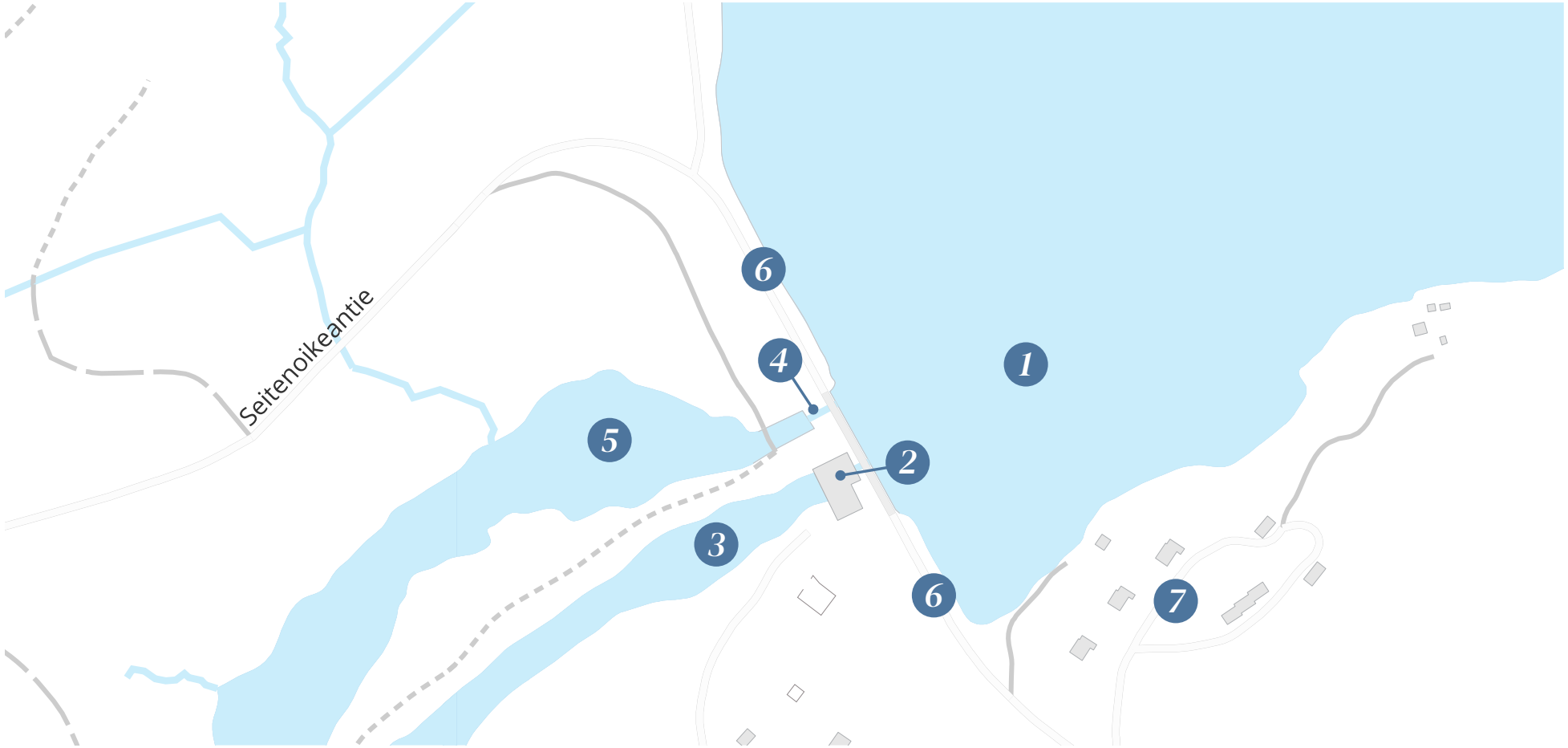
**Powerhouse:** In-situ concrete frame, cladded with profiled aluminium sheeting.
**Dams:** Concrete regulating that has one spillway opening with a radial gate. Long earth dam with a moraine core.
**Special features:** Built in the middle of wilderness.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Regional plan

*1 Kuuskoski 1991, 50-51*
*2 Ibid*

## Location


*Seitenoikea is located on the River Emäjoki in Ristijärvi municipality. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

## Functional arrangement




*Site map of Seitenoikea. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

Water is directed from the forebay (1) into the powerhouse (2) turbine through the intake gaps. Water is then released into the excavated tailrace (3). The regulating dam (4) has one spillway with a radial gate and is located on the northern side of the power house. The floodwater is released into the old riverbed (5). Embankments and earth dams (6) are built around the power plant to form the forebay. The small residential area (7) is built on a gently sloping ridge on the eastern shore of the bay.

*Seitenoikea during construction. Photo: Foto Roos © Fortum Power and Heat.*


*The structures for the machine hall are being casted. Photo: Foto Roos © Fortum Power and Heat.*

*The log crane and power house of Aittokoski. Photo: Pekka Elomaa © Council of Oulu Region.*

## Architecture

Architecturally, while Seitenoikea is rather similar to Aittokoski, the construction site of Seitenoikea is less dramatic. The rectangular-shaped concrete frame of the powerhouse is mined inside the bedrock and cladded with profiled aluminium sheeting, giving it the same, sleek, machine-like aesthetic as that of Aittokoski. The powerhouse also has a mono-pitched roof.

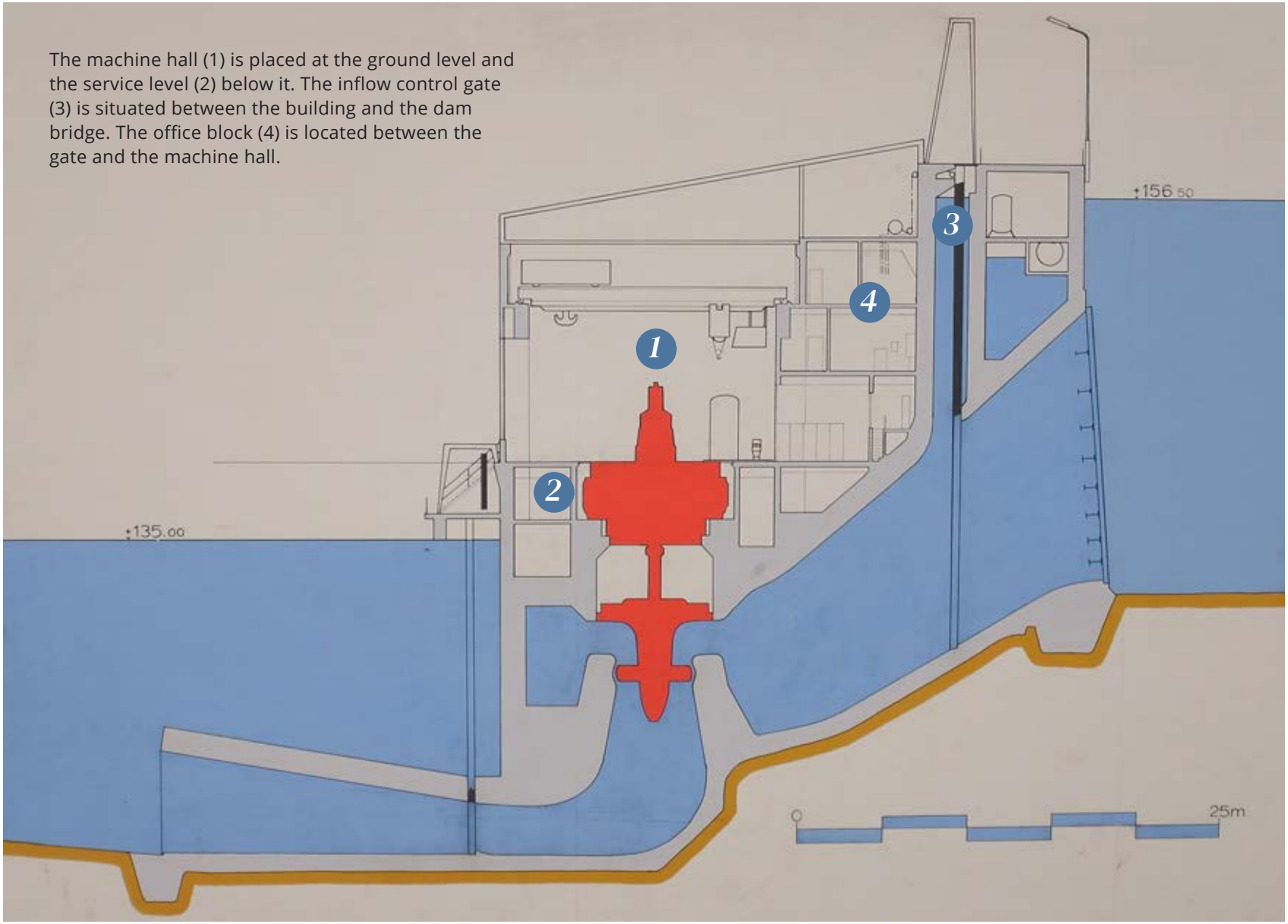
The building is placed next to the regulating dam, which has been extended by a long earth dam. The dams and embankments form the forebay. As in Aittokoski, the view from the forebay reveals very little, as the powerhouse is almost unnoticeable. The residential area is placed on the ridge on the eastern side of the power plant.

The organisation of the powerhouse is composed around the machine hall that is at ground level. The service level is located below the machine hall so that parts of the machinery that need maintenance can be lowered to the service level chasm by the girder crane that runs inside the machine hall.

The contrasting colours of red, yellow and blue dominate the machine hall. The striped floor is also a familiar feature of Ervi's earlier powerhouses.

Like Utanen and Ämmä, Seitenoikea does not have a gate hall and the inflow control gate is raised outside the envelope of the building. The office block is located between the gate and the machine hall.

Large windows open up toward the tailrace and the large steel door provides access to the machine hall.



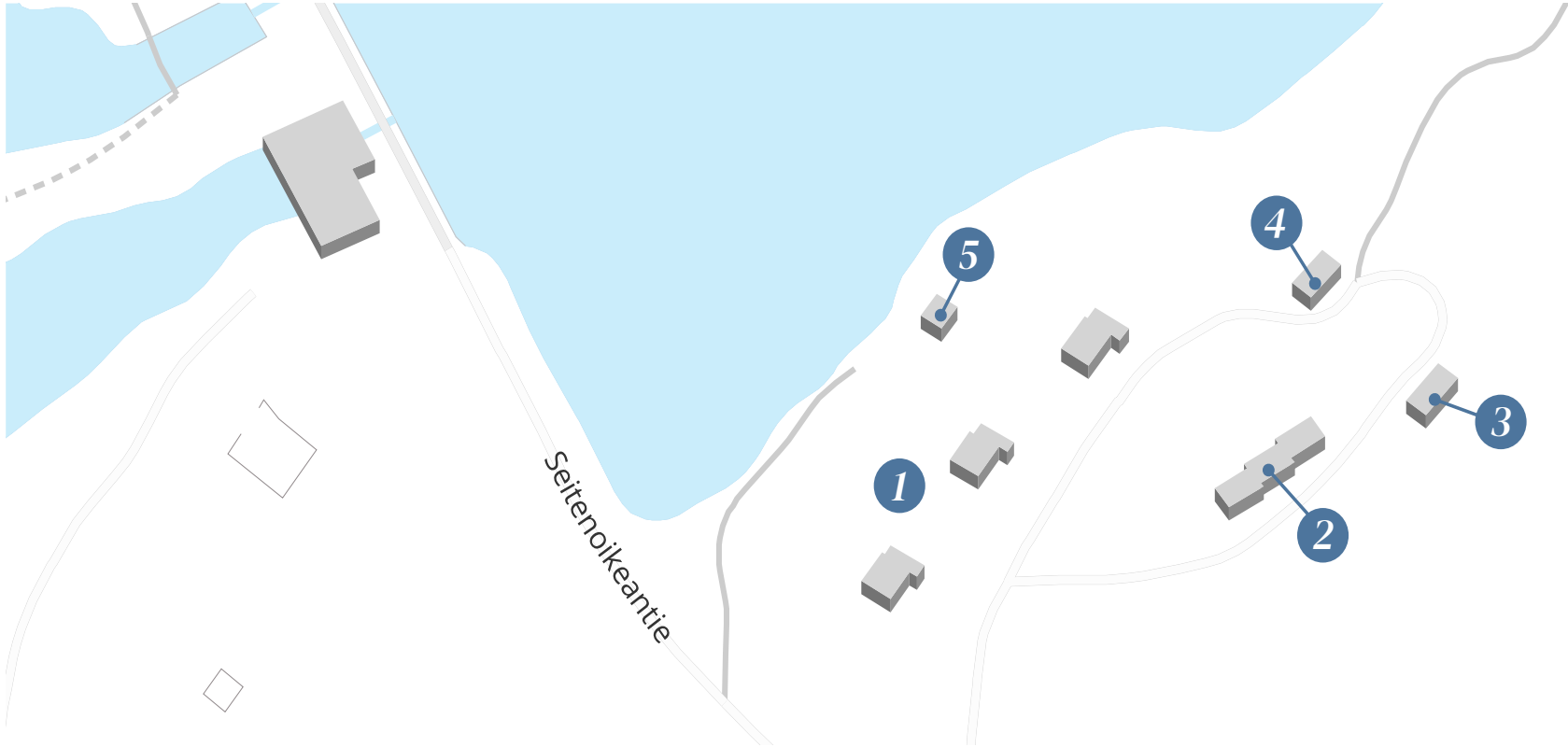

*Ervi, section of the Seitenoikea powerhouse. © Fortum Power and Heat.*

The completion of Seitenoikea in 1961 marks the end of the hydropower designs by Ervi. This twenty-year period that began with Pyhäkoski in 1940 is reflected as an evolutionary process that involved Ervi's personal ambitions merging with the current general values, possibilities and limitations of the time.

During this period, Ervi moved from the rigorous functionalism of Pyhäkoski to the transparency, flowing façades of Pälli, Nuojua and Montta, and on to the ever more lighter, rational and cost-efficient designs on the River Emäjoki.

*The machine hall of the Seitenoikea powerhouse. The contrasting colours red, yellow and blue dominate the machine hall. The striped floor is also a familiar feature from Ervi's earlier powerhouses. Photo: Pekka Elomaa © Council of Oulu Region.*

## Residential area




*The residential area of Seitenoikea. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

The houses in the residential area of Seitenoikea were mostly built in the late 1950s on the eastern shore of the forebay. The garage was built in the early 1960s and the row house at late 1960s. The area was designed by Aarne Ervi and his office except for the garage and the row house. The houses are placed around a circular road.

The area consists of:

Three detached single-family houses (1)
Row house (2)
Garage (3)
Service building (4)
Sauna (5)

The detached single-family houses are the same house types that Ervi designed in Leppiniemi and Ämmä. The only difference is that these houses are mirror images to those in Leppiniemi and Ämmä. Seitenoikea has two smaller houses, house type B5, and one larger house, house type B6. The rowhouse has three apartments and sits at the top of the ridge.

*The larger house type B6 in the Seitenoikea residential area. Photo: Kirsti Reskalenko © Council of Oulu Region.*

The larger house type, B6, has three bedrooms and a garage. The building has a concrete foundation, wooden balloon frame with a board and batten cladding as well as a tile roof. Additional insulation was added later to the exterior walls and to the foundation. This has altered the appearance of the house slightly. The house is situated so that the living room windows face the beautiful scenery towards the forebay. The house is still in use and in good condition.

*Type house B6 as seen from the waterfront. Photo: Kirsti Reskalenko © Council of Oulu Region.*

*A row house of Seitenoikea. Photo: Kirsti Reskalenko © Council of Oulu Region.*

The row house is built on top of the ridge with a view from the windows to the forebay. The designer of the house is unknown and it was built in the late 1960s. The terraced frame of the building is constructed out of wood and has a board and batten cladding. The building also has a concrete foundation and a sheet metal roof.

The house has a total of three small apartments. In the 1960s, an additional garage was built for the residents of the row house. The simple balloon framed building with a mono pitch roof is located right next to the row house.

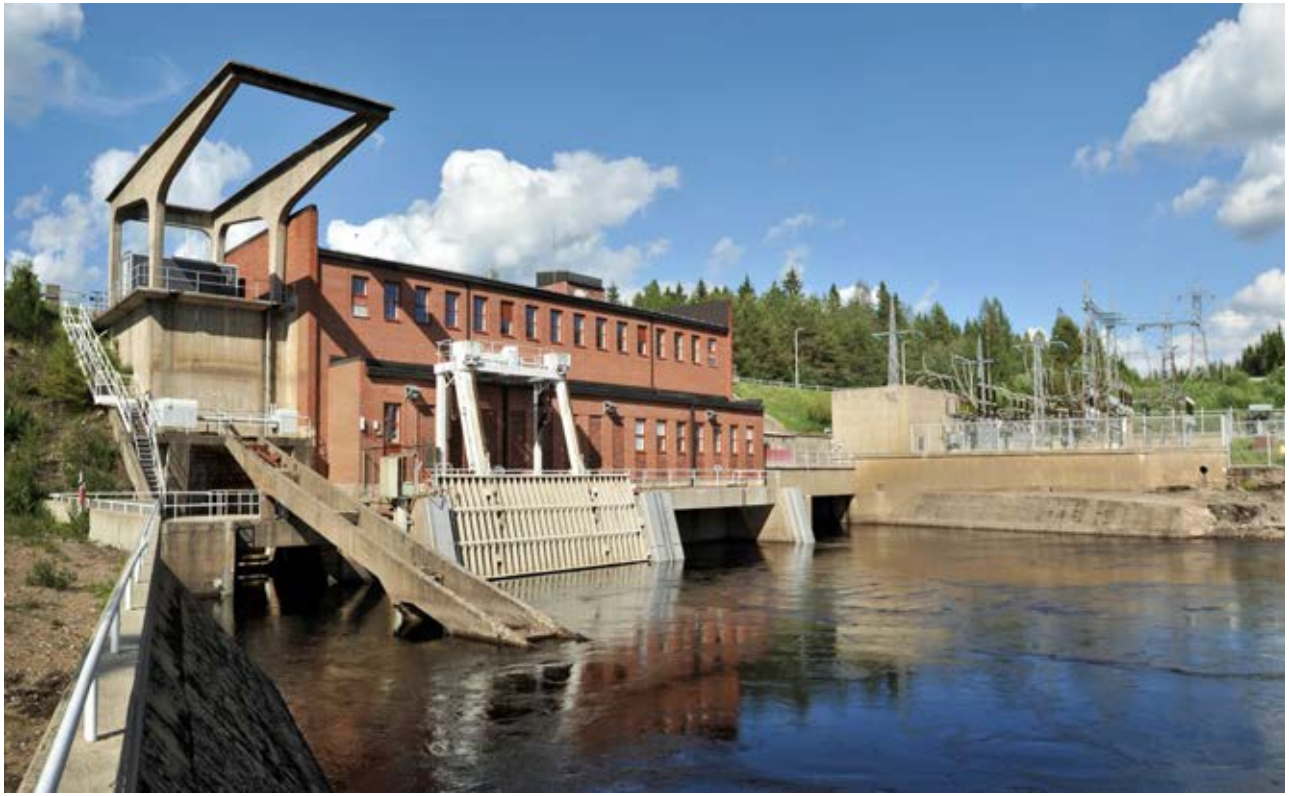
The log-frame communal sauna is built right at the waterfront.

*The garage was built in the early 1960s for the residents of the row house. Photo: Kirsti Reskalenko © Council of Oulu Region.*

*The log-constructed sauna at the waterfront. Photo: Kirsti Reskalenko © Council of Oulu Region.*

*Seitenoikea has a small service building that includes a sauna, washing room and two garages. Photo; Kirsti Reskalenko © Council of Oulu Region.*

# 5.3.5 Leppikoski



*The Leppikoski power plant is located on the River Kiehimäjoki. Photo: Pekka Elomaa © Council of Oulu Region.*

### Technical information

**Power plant type:** Run-of-river
**Contractor**: Kajaani Inc.
**Owner:** Fortum Power and Heat
**Built:** 1960-1963
**Designer:** Reino Laaksonen, M.Sc. (Eng)
**Machinery:** One Kaplan turbine with vertical axis
**Capacity:** 23 MW
**Head**: 11.1 –13.3 m
**Flow**: 220 $m^3/s$
**Powerhouse:** On-site casted concrete frame, brick facades
**Dams:** Concrete regulating dam. Two spillway openings with a radial gates.
**Special features:** Bought by Oulujoki Power Company from Kajaani Inc. in 1962.
**Protection status:** Classified as RKY (Nationally significant built cultural environment - RKY 2009: Hydropower plants on the Oulujoki and Sotkamo routes)
**Zoning status**: Regional plan

Leppikoski is located on the River Kiehimäjoki in the municipality of Paltamo. It began as an independent project by Kajaani Inc. in 1960. In 1962, Oulujoki Power Company purchased the power plant that was under construction. They also bought the property and a section of the river. Leppikoski was finished in 1963.

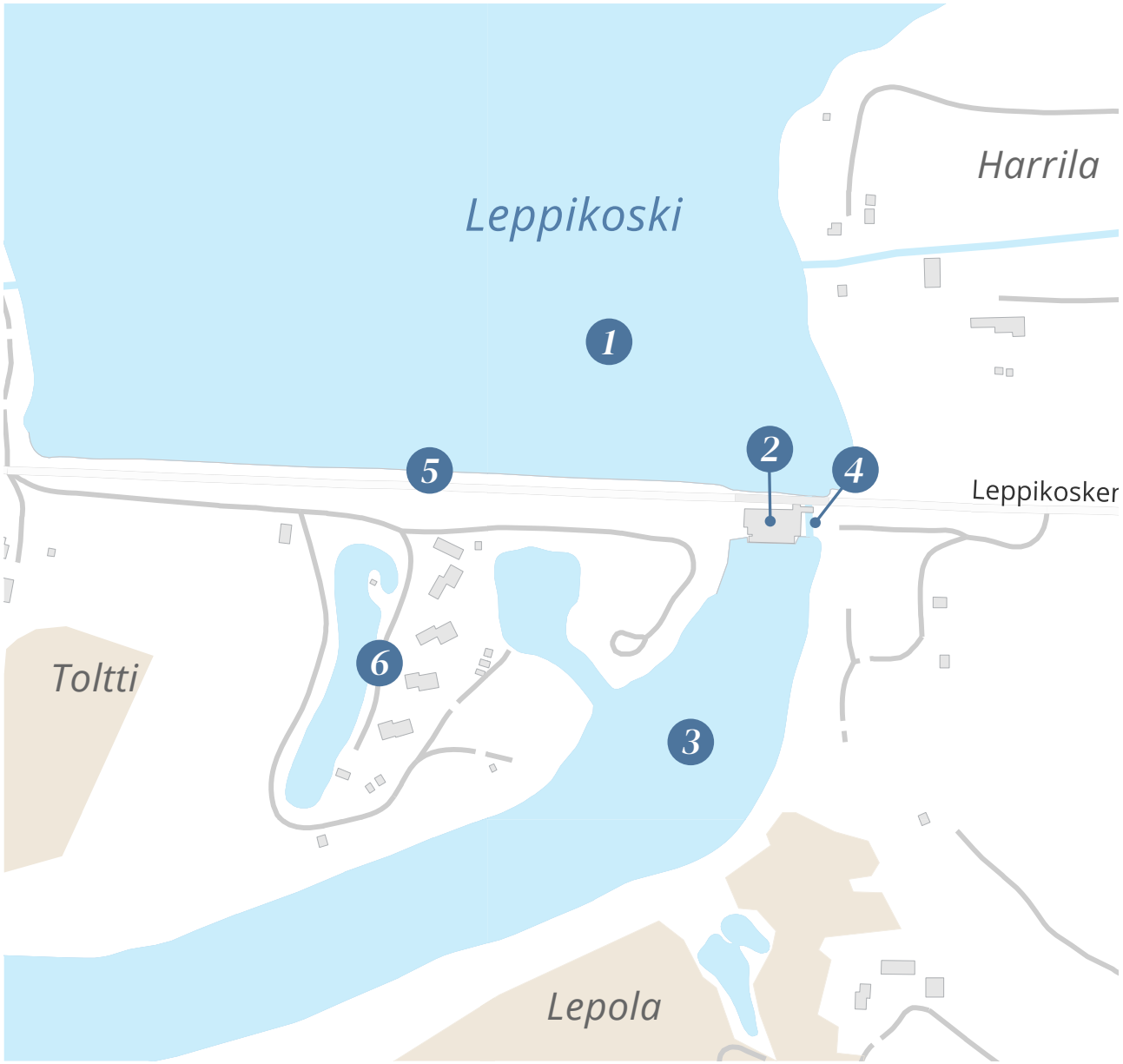
Reino Laaksonen designed the brick-built powerhouse. The two sets of machinery were connected to the power grid on 5 December 1962 and 8 February 1963. Leppikoski has a capacity of 23 MW.

## Location


*Leppikoski is located on the River Kiehimäjoki in Paltamo municipality. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*

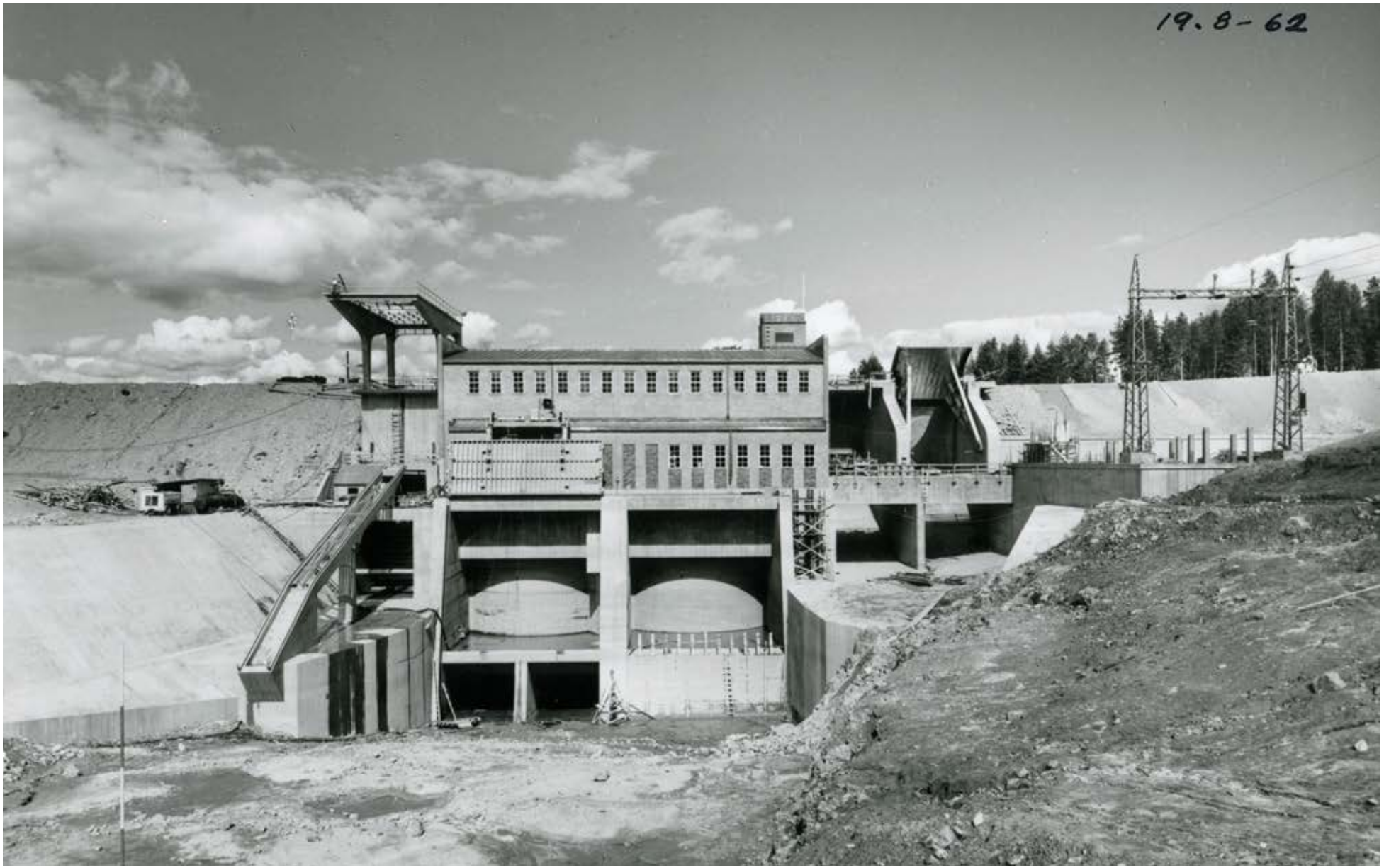
## Functional arrangement

Water is directed from the forebay (1) into the powerhouse turbine (2) through the intake gaps. Water is than released into the tailrace (3). The regulating dam (4) has one spillway with a radial gate and is located on the eastern side of the powerhouse. The floodwater is also released into the tailrace. The embankments and earth dams (5) were constructed on the western side of the power plant to form the forebay. The small residential area (6) is built on the western side of the power plant.




*Site map of Leppikoski. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*


*Leppikoski as seen from the headrace. The spillway gap of the regulating dam is visible on the left and the intake gaps for the turbine are on the right. Photo: Foto Roos © Fortum Power and Heat.*




*The power plant is finished but the tailrace is still dry. Photo: Foto Roos © Fortum Power and Heat.*

## Architecture

The history of the Leppikoski hydropower plant dates back to the early 1900s. At that time, a hydro-powered paper mill was planned at the rapids of Leppikoski on the River Kiehimäjoki. The mill was never built but the location was nevertheless considered to be appropriate for a hydropower facility. Because of this, the design process of Leppikoski originated from different premises.

Leppikoski was designed by Reino Laaksonen (M.Sc., Eng). Laaksonen designed the powerhouse with a simple rectangular-shaped concrete frame and cladded it with unplastered brick. The main façade is perforated with small window openings that are, for some reason, partly sealed with bricks. The building has a mono pitch roof, but the gabbles are raised above the eaves so that when viewing the building from the side, the building appears to have a flat roof. The most striking architectural feature of the power plant is the concrete log crane.

The organisation is composed around the machine hall. The service block and offices are placed on the side of the tailrace. As a result, the interior lacks natural light and the dark colours of the machine hall reinforce this effect.

Leppikoski does not have a gate hall and the inflow control gate is raised with the crane that is located between the powerhouse and the dam bridge.

*The machine hall of Leppikoski. Photo: Pekka Elomaa © Council of Oulu Region.*

The building has an overall appearance that is reminiscent of the industrial architecture of the late 1800s.

The slightly incoherent end result suggests that in his design process, Laaksonen was more interested in the rudimentary aspects of hydropower engineering than architectural finesse.

## Residential area

Leppikoski has a small residential area located on the western bank of the tailrace next to an artificial pond. The area was designed by the architect Eino Pitkänen and was built in the early 1960s. The additional garage (3) was constructed in the 2000s.The area also has several light storage buildings built on the waterfront.

The area consist of:
Four single family detached houses (1)
Sauna (2)
Garage (3)


*The Leppikoski residential area. Map editing and stylization: Design Inspis Oy. Original map material: National Land Survey of Finland, Topographic Database.*


*Single-family house at Leppiniemi. Photo: Samuli Paitsola © Council of Oulu Region.*

Pitkänen's single-family houses have a balloon frame that is cladded with clapboarding. The houses also have concrete foundations and roofs made out of sheet metal. Two of these two-bedroom houses also have a storage built as an extension to the garage.

This has understandably altered the appearance of the houses. Because of the vertical, quite inconspicuous, overall appearance of the houses, they adapt well to the surrounding nature.

Today the houses are in good condition and well maintained. The landscape and also is well cared for.

# 6. Results of the Inventory and Evaluation of Architectural and Cultural Values

The VekuVaku project was implemented between 1 January 2019 and 30 September 2022. This atlas was completed in the spring of 2022. The last chapter contains a summary of the results of the inventory. The atlas also offers reflections on the architectural, cultural and social values of these places and examines the changes that have occurred. The Oulujoki project should also be seen in a larger context and this chapter attempts to shed light on this side as well.

## Results of the inventory

After compiling the inventory for the sites along the River Oulujoki water system during 2019 and 2020, certain presuppositions have been confirmed. It is clear that the architecture can be evaluated as significant, substantial and of a high aesthetic quality. The finest examples of Ervi's power plants can be considered world-class industrial architecture and the residential areas highlight some of the best features of Finnish modernist housing. This was confirmed at the national level in 2009 when the hydropower architecture on the River Oulujoki waters was awarded the status of RKY (Nationally significant built cultural environment). This status was granted by the Finnish Council of State. The power plants on the River Oulujoki have also been selected as examples of modern Finnish architectural masterpieces on DOCOMOMO sites.

During this project, a structural framework was created to create the inventory. This model was formulated in order to provide basic information about individual buildings as well as to find answers to the following two questions:1) What condition are the buildings currently in, structurally and aesthetically?; and 2) What is the status of the preservation of these buildings and sites? The latter question basically refers to the type of changes the buildings and sites have gone through.

A five-tiered classification system was adopted to determine the condition and also to assess how well each building has been preserved. The state of preservation is evaluated by the following categories: preserved, partially preserved, changed, thoroughly changed and no longer original. The qualification is also quantified so that preserved is awarded four (4) points; partially preserved three (3); changed given two (2); thoroughly changed earns one (1); and not original at all zero (0).

The structural condition of the buildings is also rated according to a five-tier model, the categories being: in excellent condition (four points); in good condition (three points); in mediocre condition (two points); in poor condition (one point); and ruined (zero points).

*Samuli Paitsola in Leppiniemi during the inventory in May of 2020. Photo: Samuli Paitsola © Council of Oulu Region.*

## Inventory of the power plants

The inventory for the power plants was compiled in 2019 and 2020 and was primarily executed by the project leader, Pekka Elomaa. As evaluating large concrete dams require special hydropower expertise, this evaluation focusses on the powerhouse in relation to the power plants. The inventory consists of 16 power plants. Leppikoski was designed by Reino Laaksonen M.Sc. (Eng.) and Pyhännänkoski by Matti Kallio-Koski, M. Sc. (Eng.). Four power plants, Ämmäkoski, Koivukoski I-II, Kallioinen and Katerma were designed by the architect Eino Pitkänen. Merikoski was designed by Bertel Strömmer. The other power plants were designed by the architect Aarne Ervi. The results of the inventory are presented in a chart below with each power plant is assigned a grade according to its overall condition and state of preservation.

| *Power plant* | *State of preservation* | *Condition* |
|---|---|---|
| *Merikoski* | *3,5* | *3* |
| *Pyhäkoski* | *3,5* | *3* |
| *Jylhämä* | *3,5* | *3* |
| *Pälli* | *3,5* | *2,5* |
| *Nuojua* | *3,5* | *3,5* |
| *Utanen* | *3,5* | *3* |
| *Ämmäkoski* | *3,5* | *3* |
| *Koivukoski I-II* | *3,5* | *3,5* |
| *Katerma* | *3,5* | *3,5* |
| *Kallioinen* | *3,5* | *3,5* |
| *Koivukoski III* | *4* | *3,5* |
| *Pyhännänkoski* | *4* | *3* |
| *Ämmä* | *3,5* | *3* |
| *Aittokoski* | *3,5* | *3* |
| *Seitenoikea* | *3,5* | *3,5* |
| *Leppikoski* | *3,5* | *3* |

*Chart 1. The state of preservation and condition of the powerhouses*

The power plants by Ervi earned the highest architectural grades. The plants were designed and built over a period of 20 years. His evolutionary design process can be divided into four stages. The first stage was the monumentalism as well as traditional construction techniques of Pyhäkoski and Jylhämä, the second stage was the modernism and technological progress of Pälli, Nuojua and Montta and the third stage was the advanced modernism of Utanen. The fourth stage includes the three plants along the River Emäjoki: Ämmä, Aittokoski and Seitenoikea. Characteristic features of this fourth stage include certain industrial rationalism, affordability and seriality of the construction process.

The power plants designed by Ervi also significantly affected the development of Finnish industrial architecture. Ervi's experiments with new materials were groundbreaking. His use of precast panels and window elements in Nuojua, Pälli and Montta paved the way for the mass use of prefabricated concrete panels in the 1960s. The concrete laboratory that Oulujoki power company founded in Pyhäkoski made considerable progress, especially in the field of concrete structures that were used in freezing waters. Furthermore, many of the construction methods that were adopted in these sites had never been used in Finland. These included the massive excavations and earth works of Jylhämä and Utanen and the ICOS-Veder method applied in Montta and Aittokoski.

### 6.1.2 Inventory of the residential areas

The building researcher for this project, Samuli Paitsola, compiled the inventory for the residential areas in 2020 and 2021. The water system has a total of eleven residential areas along its waters. Eight were designed by Aarne Ervi and his office, while Eino Pitkänen was responsible for the small residential areas of Kallioinen, Katerma and Leppikoski. The houses Pitkänen designed are charming and in many ways, high quality modernist architecture. However, Pitkänen's houses constitute rather typical Finnish post-war dwellings. The most unique feature of these houses are the construction sites along the canals and bays of the power plants and as a part of a larger system.

| *Residential area* | *State of preservation* | *Condition* |
|---|---|---|
| *Leppiniemi* | *3,8* | *3,2* |
| *Jylhämä* | *3,8* | *2,8* |
| *Pälli* | *4* | *3* |
| *Nuojua* | *4* | *3* |
| *Montta* | *3,25* | *3,75* |
| *Utanen* | *4* | *3,2* |
| *Katerma* | *3,75* | *3* |
| *Kallioinen* | *3,6* | *3,4* |
| *Ämmö* | *3,9* | *3,6* |
| *Seitenoikea* | *3,8* | *3,3* |
| *Leppikoski* | *3,2* | *3,6* |

*Chart 2. The state of preservation and condition of the residential areas.*

Aarne Ervi discovered a more unique approach to his design that evolved from his personal views and internal orientation. Like many in the post-war era, Ervi was exceedingly optimistic about the future and the development of technology and society. Nonetheless, he was also strongly conscious of the qualities and properties of Finnish vernacular architecture.[1] It is well documented that this dynamic idea of modernism was important for Ervi.[2]

All this manifests itself in Ervi's dwellings along the northern rivers, as while the houses are clearly modernist, they retain vernacular as well as traditional features and materials. Ervi's humane and intuitive approach to design created architecture that has sometimes been referred to as "romantic functionalism".[3] Ervi commented on this subject in his article titled "Taloudellisyys ja inhimillisyys" (Economy and Humanity) that was published in the Finnish Architectural review 9/1942.

This contemplation became the cornerstone in the design of the power plants and residential areas along the rivers Oulujoki and Emäjoki.[4] Ervi's method provided results that are unparalleled and, in many ways, timeless.

The importance of the project is also evident in the resources that were available and that expensive material and precise craftsmanship were not spared. Although the areas are in many ways heterogeneous, the finest examples, such as Nuojua or Leppiniemi, are to this day, pleasant, vibrant and full of potential. During this project, due to the restricted timeframe as well to the constraints of the Covid situation in 2020, it was not possible to visit hundreds of apartments. This means that the inventory of the residential areas pertains solely to the outward appearance of the buildings. In addition, the technical and structural condition of the buildings are evaluated externally.

As these houses were built in the 1940s and 1950s, it is understandable that the interiors have been upgraded and changed over the years. The results of the inventory are presented in a chart with each residential area assigned a numerical value according to its overall condition and state of preservation. As the areas have a different number of buildings, an average number is calculated to illustrate the overall state of preservation and condition of the areas, with four being the maximum and zero being the minimum. Furthermore, Merikoski, Ala-Utos, Pikkarala, Ämmäkoski, Koivukoski I-II, Koivukoski III and Aittokoski do not have residential areas.

*1 Hirviniemi 2010, 64*
*2 Lahti 2006, 189–200*
*3 Hirviniemi 2010, 72*

*4 Hirviniemi 2010, 64*

## Creating new communities and new cultural heritage

Life in these hydropower communities has not been previously well documented. During this project, we interviewed many people who spent their childhood and youth in these communities. Many continue to reside in these areas. These interviews have been compiled into stories and published as a book: Elämää vesivoiman ehdoilla - Tarinoita Oulujoen vesistön voimalaitoskylistä ja rantatörmiltä (Life on the Terms of Hydropower - Stories from the Power Plant Villages and Shores in the River Oulujoki Watershed). The book was edited by Salla Marjakangas (B.A). It was important to document this intangible cultural heritage now when it is still possible to obtain the original source. It is also recommended that these two publications are read in tandem as complementary works.

Certain topics arose repeatedly in people's stories. The positive aspects included issues such as experiencing a safe childhood and a sense of strong community spirit. Many people also mentioned how the whole village participated in raising children. Perhaps the most important topic that arose was work. The respondents commented on how the power plants provided work and offered life and economic opportunities for these regions. In the end, these communities revolved around work and the company that made it all possible. The fact that these communities have always been highly valued as places of residence is well documented.[1]

It is interesting that people commonly use the expression "me yhtiöläiset" (we company people) when speaking about themselves as a community. This referred not only to the people who were working for the Oulujoki Power Company but everyone living in these residential areas, including children. This ethos contained elements of pride as well as a sense of gratitude due to how well matters pertaining the community were organised. For example, these attitudes were reflected in how the company's workers took care of the landscaping, plowed the roads during winter and provided wood and oil for heating. Daycare and schooling were provided for the children as well as hobbies and even free language courses were available. During the summer, the company organised summer camps on the islands of Lake Oulujärvi. Almost everyone was employed and the company also promised that everyone aged 15 would be hired for a summer job.

Besides the architectural values, one of the most important discoveries we have made during this project was that there was a sense of communality as a sociocultural value. This also needs to be considered as an intangible cultural heritage.

*1 Hirviniemi 2010, 76*

# 6.1 Summary

The modernist architecture built along the rivers as well as the technical means that were used, place the entire project in a broader context. Of course the essential methods of modern architecture and design were standardisation, prefabricated parts, concrete technology and housing typology and the primary purpose for these power plants was to produce electricity for the industry's needs. However, it could be argued that the project had and even broader "mission". As post-war Finland was undergoing modernisation and industrialisation, it needed examples like the Oulujoki project that could illustrate that Finland, a country that only a few decades ago was a part of Russia, now belonged among the industrialised countries of the democratic West.

There are several reasons for this. The Oulujoki Power Company hired the best architects and engineers in the country to carry out the project. This indicates that the company was willing to pay for high-quality architecture and design and was not willing to settle for anything less. This is also evident from the high-quality materials and workforce. In addition, a certain level of internationality was established early on. Ervi and the company's engineers visited the power plants and construction sites in Central Europe and in the United States and these "study trips" had a major impact on the outcome. The company also published its material in English to ensure maximum international exposure. And from early on, the company aimed to showcase these areas. To facilitate the visits, a network of guesthouses and other services was built, and important guests would sometimes be flown in by helicopter.

Finland´s aspirations were also noticed in the West. It was no coincidence that the International Bank for Reconstruction and Development, which is part of the World Bank, provided loans for Finland. In its report from April 1952, the bank recognises the potential of the untapped hydropower of Northern Finland, and the enormous benefits that these construction projects could offer.[1] Furthermore, the machines that were used in the excavations were imported from the United States.

This title of this atlas, Building and Industrial Identity, refers to this fact that the Oulujoki project was an essential part of the "grand narrative" of Finland, where the country survives the war, pays its war reparations and rises to be among the prosperous industrialised Western nations.[2] These large-scale industrial projects in the north also constituted a large part of Finland´s regional politics, which meant that the regions have been developed and maintained through state-run projects and services.

The Oulujoki project should also be evaluated in a temporal context. Architecture is a phenomenon that happens in time, and this is especially true with these large-scale ventures. It is through time that the repercussions of these actions can be truly observed.

For example, cultural history of the River Oulujoki has many layers. The construction of these hydropower plants and communities added another layer to the stratification of the river's past. It is important to remember that this was not the first and definitely not the last major upheaval that these places would experience. In fact, the latest major change occurred during the 1970s and 1980s when the company began to operate remotely and to automate these power plants. The company subsequently sold the residential areas and detached itself from the daily lives of the residents, causing a complete change in the dynamics of how these communities operate.

*1 https://documents1.worldbank.org/curated/en/472601468249896313/pdf/multi0page.pdf. Northern and Eastern Finland play a special role in this program. These areas, although sparsely settled, are depressed, since industrial employment opportunities there are not plentiful, while lack of roads discourages efficient exploitation of agricultural and forest resources, Yet the major untapped sources of hydroelectric energy lie in these areas. The hydroelectric and land clearance and forest road building programs thus offer at one and the same time an opportunity to alleviate unemployment in the north and east, and to open these lands to more extensive exploitation. The same is true, though to a lesser extent of some of the woodworking projects.*
*2 Rautiola, Matti in the book Rakennetun Suomen tarina (Hautajärvi toim. 2017, 5)*

That change also altered the function of these power plants as well as the use of their different spaces. Today, the control rooms, offices and break rooms are empty, and the hustle and bustle of work has been replaced by dust and emptiness. In the future, a time may come when hydropower is no longer needed and new solutions and usage for these structures will be discussed.

In recent years, there have been discussions concerning how to preserve these sites and it has been decided that planning is the best method to achieve this. At the moment, the sites and buildings are listed in regional plans. The first detailed plan to really ensure the preservation of the area was drafted in Ämmä, in the municipality of Suomussalmi in 2005. This plan also includes instructions for maintaining and renovating the buildings. The district plans were drafted in Jylhämä, Nuojua, Montta and Pälli, in order to protect the architectural and environmental values of these areas.[3] The same type of detailed plan for Ämmä was introduced in Leppiniemi, in the municipality of Muhos in 2013. This plan also includes instructions for maintaining and renovating the existing buildings and well as drawings for possible new developments.

*3 Hirviniemi 2010, 78*

# 6.2 Conclusions on the "Case for UNESCO World Heritage site"

To be included on the UNESCO world heritage list, sites must be of outstanding universal value and meet at least one of the ten selection criteria. As stated in chapter 1.6., in his preliminary 2017 study, Veli-Pekka Huhmo concludes that the strongest world heritage criteria for the River Oulujoki water system are number two (ii) that represent the interchange of human values, and number four (iv) that appreciates architectural and technical achievements.

When considering the World Heritage value of the Oulujoki waters, one must also consider the concepts as defined by UNESCO. In this case, the three most important concepts are Outstanding Universal Value (OUV), Authenticity and Integrity. UNESCO has defined Outstanding Universal Value as follows: Outstanding Universal Value is the most important concept in the World heritage agreement. "Outstanding" tells that the site is unique in global perspective and "universal" signifies that it is meaningful for all people in the world.[1]

UNESCO defines integrity as follows: Integrity is a measure of the completeness or intactness of the attributes that convey Outstanding Universal Value. Accordingly, a clear understanding of the potential Outstanding Universal Value is required before it is possible to consider the integrity of the property. Furthermore, authenticity is defined as follows: Authenticity measures how well the site conveys potential Outstanding Universal Value and its attributes. Authenticity only applies to cultural properties and to the cultural aspects of 'mixed' properties.[2]

In Finnish, authenticity is commonly thought to mean the originality of the building or site.[3] This leads to confusion with these terms. For the inventory model created for this project, the term "state of preservation" is used to signify and evaluate the originality of the buildings and sites.

In his preliminary study, Huhmo (2017) also conducts a comparative analysis of the existing world heritage sites and the hydropower architecture of the River Oulujoki Water System. He reports certain similarities with various sites but fails to find anything equal. The Finnish Heritage Agency states in a report that the hydropower community of Rjukan-Notodden in Norway is similar to the Oulujoki waters. However, different views on this could also be expressed. For example, Huhmo (2017, 106) concludes that Rjukan is a compact city that is surrounded by fjords, whereas the rivers in the Oulujoki waters are harnessed with a chain of hydropower plants that stretches over hundreds of kilometres and work together synchronously as a complete mega system. The observations made during this project support this claim.

The VekuVaku project, which is now coming to an end, has predominantly focussed on the cultural environment, architecture as well as on socio-cultural factors. In the future, as the Finnish Heritage Agency has pointed out in its report, the focus needs to be on the technical and historical factors of the project. By doing this, the chances of achieving World Heritage status for the hydropower architecture of the River Oulujoki water system will be greatly improved.

*1 Huhmo 2017, 10*

*2 Preparing World Heritage Nominations (Second edition, 2011) 2011, 62*
*3 Tolonen 2018, 10*

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