Rjukan-Notodden (Norway) No 1486

Official name as proposed by the State Party
Rjukan-Notodden Industrial Heritage Site

Location
Telemark County

Brief description
Located in a dramatic landscape of mountains, waterfalls and river valleys, the Rjukan-Notodden Industrial Heritage Site comprises a cluster of pioneering hydro-electric power plants, transmission lines, factories, transport systems and towns. The complex was established by the company Norsk-Hydro to manufacture artificial fertilizer from nitrogen in the air in response to the Western world's demand for increased agricultural production in the early 20th century. Rjukan and Notodden company towns, 80 kilometres apart, include workers' housing and social institutions connected by railway lines and ferry services to ports of embarkation for the fertilizer and other products. Three of the pioneering power plant buildings (Vemork, Såheim and Tinfos II) constructed between 1905 and 1940 are intact and still in use.

Category of property
In terms of categories of cultural property set out in Article I of the 1972 World Heritage Convention, this is a *site*.

1 Basic data

Included in the Tentative List
26 November 2009

International Assistance from the World Heritage Fund for preparing the Nomination
None

Date received by the World Heritage Centre
30 January 2014

Background
This is a new nomination.

Consultations
ICOMOS consulted TICCIH and several independent experts.

Technical Evaluation Mission
An ICOMOS technical evaluation mission visited the property from 1 to-5 September 2014.

Additional information received by ICOMOS
A letter was sent to the State Party on 20 August 2014 requesting additional information on the industrial processes, boundaries, protection and management and future development projects. Some information was provided to the technical evaluation mission and received on 19 September 2014 & 6 October 2014 including the timetable for legislation and approval of the Management Plan, explanation of legislative changes, information regarding items in the buffer zone and future development projects. A response to the letter was received on 6 November 2014. A second letter was sent to the State Party following the ICOMOS Panel in December 2014 regarding extension of the property boundary and completion of the legislative protection of the property, together with some management and monitoring issues. A telephone meeting between the State party and ICOMOS was held on 15 January 2015 at the request of the State Party to clarify some points in ICOMOS' second letter. A response was received on 26 February 2015. The information has been incorporated below.

Date of ICOMOS approval of this report
12 March 2015

2 The property

Description
The nominated property comprises the interlinked water courses from the Møsvatn regulating reservoir on the Hardangervidda mountain plateau down to Heddalsvatnet Lake, a stretch of 93km and covers a total area of 4959.5ha. It includes the elements of four interrelated functions or themes: hydroelectric power production, electro-chemical processing industry, the transport system and two company towns Rjukan and Notodden. These are surrounded by a buffer zone of 33,967.6ha.

Hydroelectric power production

The hydroelectric power generation system was developed by Norsk Hydro to exploit the water drops totalling over 700 metres from the high plateau created by the waterfalls of Tinnfossen, Svælgfos and Rjukanfossen. Cheap electricity was required to manufacture synthetic nitrogen fertilizer based on the energy-intensive, electro-chemical Birkeland/Eyde process. The first test facility utilised the Tinfos I power plant outside Notodden from 1901. The gable-roofed, plastered brick building remains as a shell and is used as a workshop. This was followed by Hydro's Svælgfos (1907) which at the time was the second largest power plant in the world after Ontario Power by the Niagara River. Today this is represented only by the stone building which was the lightening arrester house and workshop. The major Hydro pioneering power plants along the interlinked water courses include Tinfos II (1912) with original decorated interiors, fixtures and fittings largely intact; the decorative stone-clad concrete Vemork power station at Rjukan (1911) fed by a high

pressure system with a great head of water and rock tunnels, regulated by the concrete dam at Møsvatn, and Såheim (1915), a distinctive concrete building with cupola-capped towers. Other architectural elements include the old stone intake gatehouse at Vemork; the penstock valve house at Vemork which remains encased in the concrete applied by the Germans to protect it during WWII; concrete workshop buildings associated with Såheim, the concrete Cable House (1915), transformer and distribution station (1915) and remains of power distribution lines. Vemork was possibly the world's biggest power plant when it began operation, and Såheim larger still in terms of output. In world terms however, ICOMOS notes that the important advances in hydroelectric power were really in distribution capability to distant cities and industries rather than output in kilowatts.

Industrial facilities

Norsk Hydro's test factory for the production of nitrogen from the air in order to produce synthetic fertilizer was created at Notodden. This was already a traffic hub and industrial community due to the Tinfos AS Company which was first a paper manufacturer and later developed an ironworks. Today the shell of the concrete Tower House A (1907-21) remains at Notodden, together with other buildings including the rendered brick and concrete Calcium Nitrate Factory (1915-16) which has been much altered, Furnace House C (1907-9), the Testing Plant and Electrical Workshop (1909), Laboratory and Workshop (1915), Hydrogen Factory (1927), the Ammonia Water Plant (1914-16) and the Minaret, a 63m high concrete tower used as air intake for the production of gaseous nitrogen in the ammonia production process.

The facilities at Rjukan were built for large scale production by Hydro and were much more extensive. Here the Furnace House and the Tower House were prominent elements in a production line based on the electric arc process. Remaining buildings at Rjukan include Furnace House I (1910-11) comprising five gabled halls, steel framed and clad in brickwork, the brick Boiler House (1911), Laboratory (1911), Nitrogen Plant (1928), Compressor House (1928), and retains a complete acid tower as a freestanding object, the only one remaining from the original 32 in Tower House 1 (now demolished). This is a granite tower which enclosed limestone quartz aggregate through which water percolated to absorb nitrous gases and produce nitric acid as a stage in the nitrate production. At both sites industrial production has continued inside Hydro's buildings adapted for enterprises that are historically linked to Hydro.

Transport system

An interconnected transport system of two railways lines and two steam-powered ferry crossings joined Rjukan's facilities to Notodden to enable the saltpetre to be transported on to world markets via the Telemark Canal. The railway was electrified in 1911 and is largely intact including railway buildings, ferry quays and two ferries now installed as part of the Norwegian Industrial Workers Museum at Vemork. Important structures are tunnels and bridges including the Gaupesprang riveted steel truss bridge (1909); the picturesque Notodden old railway station building (1908-9); Rjukan Quay (1909 - the Railway Quay); Tinnoset Railway Station buildings (1909); Tinnoset Ferry Quay and buildings (1909); 10 of the original 11 lighthouses along Tinnsjøen Lake (1908/1939/1962), Mæl Ferry Quay 1909; Mæl Railway Station 1909/1917; Mælsvingen houses (c 1914); Ingolfsland Railway Station; Rjukan Railway Station; Såheim Engine Shed; together with railway track, signalling and overhead line equipment. The line closed in 1991 and its ownership together with that of the ferry quays, slipways, lighthouses, railway stock, tracks and railway buildings was transferred to the Rjukan Line Foundation in 1997. In 2012 ownership was transferred to the Vemork Museum.

Rjukan and Notodden Company towns

Notodden
Workers' housing in Notodden was provided by both Tinfos AS and Hydro, expanding the original settlement which served the surrounding farming community. The Hydro housing areas of Grønnebyen (1906) and Villamoen (1908) are located on terraces above the factory and the lake, with Own Homes (1910-14) and Tinnebyen (1917-20) to the east. Hydro housing is also located at Svælgfos (from 1905) and Lienfos (from 1909) north of the urban centre. Hydro is credited with laying out the commercial centre and also built a primary school, theatre and municipal baths – now all demolished - a hospital which still exists and an administration building. The housing layout reflects garden city ideals and architecture of the period.

Rjukan
This was a self-contained model company town created by Hydro based on ideas drawn from Sweden and Germany and laid out along both sides of the Mana River. The housing was mostly along the north side in order to maximise sunlight and stratified according to social order with workers' housing lower down. Over 140 house types were designed often by German-trained architects in both wood and brick and following modern ideas of light and ventilation. Bathrooms with hot water, a flush toilet and electric lighting in every apartment were intended to attract workers, who would get an opportunity to buy their own home. The town reached its peak of around 12,000 residents in 1920, when it was the largest industrial town in Norway. Schools, children's home, parks, hospital, library, post office, sports grounds and halls were all built by Hydro, as well as the necessary infrastructure, again reflecting garden city ideals. The prestigious buildings were designed by recognised architects in styles varying from historicism, art nouveau, neoclassicism to functionalism. Power plant buildings were constructed using reinforced concrete, steel and glass.

A catalogue of existing buildings and structures considered to be attributes of the property's value is included in the nomination dossier.

History and development

Telemark is a traditional farming area and the development of the Rjukan-Notodden hydroelectric scheme, saltpetre factories and towns required the purchase of farms on which to build. The area is also rich in mineral resources which have been mined in the past. The watercourses had been used in earlier centuries for waterwheels to generate power for mills and saws and floating timber from the forests to the saw mills. From the 18th century the mountains and waterfalls also attracted tourists. The existing conditions which enabled the establishment of Hydro's large factories for production of fertilizer were the canalised river system with locks connecting to the sea; the Tinfos power plant which could be used for the test factory, and the water drop of the Rjukanfossen waterfall which could be harnessed for the large amount of cheap energy required.

The establishment of the Norsk Hydro Company by engineer and industrialist Sam Eyde in 1905, the year of Norway's full independence opened the way for large-scale industrial development in Telemark. At the beginning of the 20th century the world's known natural sodium nitrate resources (saltpetre) in South America were greatly depleted and the search was on to find a synthetic replacement to increase crop yields in advance of the predicted food crisis. Development of the alternating current system of electricity in the late 19th century and its use at the first power plant at Niagara Falls paved the way for the use of hydroelectricity to power Birkeland's electric arc furnace which drew nitrogen from the air, producing 'Norway saltpetre'. Working with engineer and entrepreneur Sam Eyde, who had studied in Germany and had business and social connections both there and in Sweden, the two brought together expertise and financial capital from a wide range of sources. By 1912, Hydro was contributing 71,000 tonnes to the world's fertilizer market.

During WWI ammonia nitrate became more important as it could be used to make explosives and Hydro built an ammonia nitrate plant at Notodden. After the war the focus returned to agricultural fertilizer and by 1920 production of Norway saltpetre amounted to 135,000 tonnes, doubling every ten years until it became the largest nitrogen exporter in Europe by the 1950s. In the inter-war period Hydro changed to a production method based on electrolytic hydrogen and new facilities were built 1928-9, with ammonia production in Notodden and continued fertilizer production using the Haber-Bosch method in Rjukan. The stock market crash led to rationalisation of Hydro's activities during the 1930s. Germany took over Rjukan's facilities during WWII and built installations to produce heavy water shipped to Germany for use in controlling nuclear fission. Rjukan consequently became the focus of sabotage attacks by the Allies and at the end of the War the Norwegian State took over as the majority shareholder due to the strategic importance of the enterprise. Hydro subsequently moved its fertilizer business and activities to Herøya near Porsgrunn in the late 1960s.

Today Notodden Industrial Park is home to around 50 enterprises and the town continues as a centre for commerce, the service industry and education. Rjukan Industrial Park accommodates 30 different enterprises in an area of 21 ha containing 34 buildings. The town is regarded as a tourism centre for Tinn Municipality.

The East-Telemark watercourse continues to be used for hydroelectric power production and as a tourist waterway. The original Tinfos II, Vemork and Såheim power stations are still intact and in operation. They have been supplemented by several new plants which have generally been constructed in rock caverns. The visible façade of the New Vemork power plant located in a rock cavern behind the old power plant is a Brutalist-style concrete structure. The old Vemork power plant now houses the Norwegian Industrial Workers Museum with its exhibition, offices, cafeteria and shop. The original generator sets still in place in the generator hall form part of the permanent exhibition of the museum. The old Tinfos I power plant remains as building shell. The New Tinfos I plant (1955) is a Functionalist-style building of painted concrete. The lakes and rivers are no longer used commercially except for tourist vessels.

3 Justification for inscription, integrity and authenticity

Comparative analysis

The State Party points out that the comparative analysis for this property needs to be seen in the light of the ICOMOS 'Filling the Gaps' report of 2005 which highlights typological, chronological-regional and thematic categories into which this property fits. Within Norway the property is compared with Odda and Tyssedal on the Tentative List which represents the exploitation of the natural topography for use of hydroelectric power to produce artificial fertilizer by the carbide and cyanamide processes. The industrial process could be seen to complement that at Rjukan-Notodden but the overall establishment does not include transport infrastructure or a company town and is thus less representative of the overall enterprise. The property is also compared with Hydro's establishment at Herøya near Porsgrunn where the company established the world's biggest calcium nitrate factory in the 1920s with options for both sea and overland transport and to which it moved its activities from Rjukan-Notodden in the late 1960s. This represents the industrial phase that followed the pioneering plants at Rjukan-Notodden but is said not to demonstrate the same values at similar depth. Other industrial enterprises referred to in Norway are said to either represent a later phase of industrial development or do not reflect similar values.

The property is compared with World Heritage listed properties at Ironbridge Gorge, UK (1986, (i), (ii), (iv) & (vi)); Blaenavon Industrial Landscape, UK (2000, (iii) & (iv)); New Lanark, UK ((2001, (ii), (iv) & (vi)); Saltaire, UK (2001, (ii) & (iv)); Crespi d'Adda, Italy (1995, (iv) & (v)); Volklingen Iron Works, Germany (1994, (ii) & (iv));

Zollverein Coal Mine Industrial Complex in Essen, Germany (2001, (ii) & (iii)); and Salins-les-Bains & Royal Saltworks of Arc-et-Senans, France (1982, 2009, (i), (ii) & (iv)), none of which represent the same period and type of global industrial development. Humberstone & Santa Laura Saltpeter Works, Chile (2005, (ii), (iii) & (iv)) is similar in responding to the world-wide demand for fertilizer but not in terms of the combination of hydroelectricity and electro-chemical processes.

The property is also compared with properties on the Tentative List at Ivrea, Italy; Industrial complexes at Ostrava, Czech Republic; Kyushu and Yamaguchi, Japan; La Constancia Mexicana, Mexico; Pilgrim's Rest Reduction Works, South Africa and other relevant enterprises in UK, Germany, Sweden, France, Switzerland, Austria, and particularly Canada and the USA, where the Niagara Falls were the site of the beginnings of hydroelectric power and electro-metallurgic industry. The State Party argues that Rjukan-Notodden stands out as representative of the new form of global industrial economy based on electricity in the early 20th century by the way it was organised and financed in one overall project. The State Party suggests however that in relation to hydroelectric power generation reflecting the importance of electricity, a number of sites could be combined as a transnational series. ICOMOS considers that in fact the restriction of the tie-in of power production to the limited purpose of fertilizer production at Rjukan-Notodden meant that by comparison the Niagara plants in particular supplied greater capacity for more uses distributed over far greater areas. However ICOMOS concurs with the State Party's claim that the nominated property is clearly distinguished by its combination of industrial themes and assets which together make it an exceptional representation of early 20th century industrial development.

ICOMOS considers that the comparative analysis justifies consideration of this property for the World Heritage List.

Justification of Outstanding Universal Value

The nominated property is considered by the State Party to be of Outstanding Universal Value as a cultural property for the following reasons:

- Ground-breaking industrial development as electricity replaced coal as a source of energy
- Testament to social transformation in the Western world at the beginning of the 20th century
- Created to produce a product (synthetic fertilizer) considered essential for the future of civilisation
- Representative of the exchange of results from science and research across national borders
- A complete ensemble of the contributing elements of hydroelectric power, industrial production, transport system and company towns created as one project.

ICOMOS considers that the first point of this justification needs to consider that coal-fired and oil-fired electricity also powered new global industries in the early 20th century. It would be more appropriate to say "ground-breaking industrial development using electricity as a source of energy". ICOMOS considers that the other points are appropriate.

Integrity and authenticity

Integrity

In general all important remaining physical structures and objects that are testimony to the industrial pioneering period of the production of artificial fertilizer for agriculture in Norway in the early 20th century are within the boundaries of the nominated area. ICOMOS notes that the ruins of Svælgfos I power plant, the Lienfos Dam and the foundations of the nitrogen and the ammonia gasometers at Rjukan together with some other structures within the nominated property are not considered as attributes by the State Party because of their ruinous state, but are considered as "supporting values" . ICOMOS considers that they are integral to the hydropower and fertilizer production and should be maintained as part of the nominated property. ICOMOS notes that the ruins of Svælgfos II power plant, transformer station, plant operations manager's residence, penstock foundations, a section of the Svælgfos-Tinfos timber flume, and Lienfos power station remains which are part of the Svælgfos and Lienfos cultural environments are not included within the property but are in the buffer zone, although said to be part of the pioneering period of significance of the site. According to the State Party this is because of their lack of integrity and authenticity. ICOMOS also notes that there are also nine other power stations which are specified neither as attributes, nor as "supporting values". Additional information provided by the State Party in response to ICOMOS' query on this states that these were all built many years later than those relating to the key period of the property and all except New Tinfos I power plant (built in 1955) are located in the buffer zone and not in visible vicinity of the older ones. While not considered an attribute of the nominated property, New Tinfos I is protected under the Cultural Heritage Act as of 20 June 2014. ICOMOS considers that the nominated property is of adequate size to ensure the complete representation of the features and processes which convey the property's significance. However ICOMOS considers that integrity would be improved by inclusion of the Svælgfos and Lienfos cultural environments within the property boundary. In response to ICOMOS' letter and subsequent telephone meeting the State Party has provided new maps showing that the boundaries now enclose these areas. The physical fabric of the property and its significant features are generally in a good condition. The property is not suffering from adverse effects of development or neglect.

Authenticity

ICOMOS considers that the overall authenticity of the nominated property and its setting is high.

Hydroelectric power production
Hydro's power plants in the Tinnelva River have mostly been demolished, but some ruins of Lienfos as well as of Svælgfos I and II are still in place. The Myrens Dam that supplied water to Tinfos I power station is now dry and its penstock has been removed. The old Møsvatn Dam and Skardfoss Dam have been replaced by new dams but are still in place beneath the higher water level.

Industrial facilities
Notodden
Since the 1950s new buildings unrelated to the fertilizer production have been added and some of the historic buildings had been demolished. However the remaining shells of the historic buildings and their positions relative to each other still convey the organisation of the electric arc production lines A (1906-1934), B (1911-1934) and the Haber-Bosch production line (1929-1968). The form and design as well as the construction material of the buildings have largely been preserved, but most of the buildings have had minor alterations (new doors, windows, colours and some extensions) and have been re-roofed, although the traditional type of roofing has been used.

Rjukan
The demolition of buildings including all but one tower since the 1950s has left large vacant spaces.
The remaining Barrel Factory has had significant changes to its façade. However, the remaining buildings with their positions relative to each other still convey the functional stages of the Rjukan I and II electric arc processes and the Rjukan III Haber-Bosch process.

Transport system
The whole transport system has been preserved, and its character and setting remain largely unchanged. Overhead line equipment is damaged and partly missing but still conveys electrification. Cranes have been removed from Rjukan Quay at Tinnoset harbour but the foundations and railway tracks remain. The lighthouses along Tinnsjøen Lake remain intact.

Rjukan and Notodden company towns
Notodden
Houses in the Grønnebyen area underwent some modernisation in the 1950s, but their general character, form, design and materials are well preserved apart from the replacement of the original outhouses by uniformly designed garages. The Villamoen area has changed to a greater degree due to new houses built by others than Norsk Hydro, but the overall 'villa' character of the settlement is retained.

Rjukan
The town plan and structure with its different housing areas and town square as well as the individual type-houses, administrative, social and infrastructure buildings remain nearly unchanged from the 1920s. Individual buildings have had inappropriate architectural alterations (windows, doors, cladding, décor and extensions) since the time Norsk Hydro pulled out, but this has not affected the area as a whole and guidelines are being prepared for improvements and restoration.

In conclusion, ICOMOS considers that the conditions of integrity and authenticity have now been met.

Criteria under which inscription is proposed
The property is nominated on the basis of cultural criteria (ii) and (iv).

Criterion (ii): *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;*

This criterion is justified by the State Party on the grounds that the results of science and research from Europe and North America were brought together in the artificial fertilizer production enterprise at Rjukan-Notodden where the natural topography enabled generation of hydroelectricity in the large amounts required for the process. Together with social innovations in workforce provision which brought together international planning ideas and innovative transport solutions, these themes combined to enable production of a new, globally significant product for the world-wide market.

ICOMOS considers that the property manifests an exceptional combination of industrial themes and assets tied to the landscape, which exhibit an important exchange on technological development in the early 20th century.

ICOMOS considers that this criterion has been justified.

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

This criterion is justified by the State Party on the grounds that the dams, tunnels and pipes to take water to the power plants; power lines to the factories; the factory areas and equipment; the company towns with workers' housing and social institutions; and the railway lines and ferry service necessary to take the product to a world market, all created within the powerful natural environment that enabled hydroelectric power production, combine as an outstanding technological and architectural ensemble illustrating new global industry in the early 20th century.

ICOMOS considers that the sites all combine as an outstanding technological and architectural complex in a natural landscape harnessed for industrial purposes.

ICOMOS considers that this criterion has been justified.

ICOMOS considers that the nominated property meets criteria (ii) & (iv) and conditions of authenticity and integrity.

Description of the attributes
The attributes are the buildings, structures and objects that relate to the pioneering period of the production of hydroelectric power and artificial fertilizer for agriculture in Norway in the early 20th century as set out in the nomination dossier. These include the Tinfos, Svælgfos, Vemork and Såheim power plants with their specified related buildings and structures; regulating dams and power transmission structures; the Hydro Industrial Parks in Notodden and Rjukan with their specified associated buildings, structures and production equipment; the Transport System including the Tinnoset and Rjukan Lines with their specified associated buildings, structures, rolling stock and ferries; Notodden and Rjukan company towns to the extent of the specified housing areas, buildings, structures and parks together with the waterways and landscape setting.

4 Factors affecting the property

The town of Rjukan has not been subject to development pressure due to its relatively remote location. Notodden is subject to greater development pressure and the proposal to upgrade the highway between Eastern and Western Norway to cross the nominated property either through or slightly north of Notodden's town centre may exacerbate this. Municipal plans have capacity to deal with increased residential density. Development pressure is significant along the valley between Møsvatn and Tinnsjøen lakes on the periphery of the buffer zone due to demand for holiday homes and tourism related activities particularly skiing. However view lines are currently affected primarily by vegetation growth. The estimated number of residents in the nominated property is 300 in Notodden and 850 in the Rjukan area.

Modifications of power plants to meet safety requirements and upgrades for increased production are considered the biggest development factors in relation to the hydroelectric power components.

The Notodden Industrial Park is subject to development pressure from new and upgraded enterprises currently controlled by zoning plans. Industrial production equipment stored in the open at these sites is subject to severe deterioration due to weather.

Notodden Railway Quay and Station will be subject to upgrade and change in the longer term due to use for new purposes subject to State and Municipal plans. The Rjukan Line is part of the Norwegian Industrial Workers' Museum but both it and the Tinnoset Line are subject to deterioration and the latter has suffered theft of overhead lines in uninhabited areas. Planned electrification of the rebuilt section of the former Tinnoset Line which connects the Bratsberg Line to the new public transport terminal just west of the Notodden Old Railway Station will require some modification to the platform at the old station building. This will be subject to relevant legislative Heritage permits.

Climate change involving a higher rainfall in Norway is expected to increase erosion and vegetation overgrowth as well as the risk of floods, landslides and avalanches. The hydro-electric power facilities enable flood control; dam reinforcement guards against dam failure, and warning systems are in place to enable evacuation in the event of a major uncontrolled discharge. Seismic activity is considered minimal; municipal and county authorities deal with landslides and rock falls on a regular basis. Threats due to strong gusty winds and fire are countered by the Municipal 24 hour fire service. The industrial enterprises comply with Norway's fire safety legislation in relation to fire protection.

The nomination dossier records that risk zone maps have been prepared and indicate that emergency procedures could be improved in relation to securing buildings prior to flood; areas subject to landslide and avalanche and response times in areas at risk of fire.

Tourism numbers swell to equal the population of the municipality in Rjukan in winter, largely due to skiing but are negligible in Notodden. It is considered that both towns have adequate capacity to accommodate a further increase in visitors, as do the industrial parks and railway/ ferry systems. The estimated number of visitors to Notodden Hydro Industrial Park is 2-3,000 annually.

ICOMOS considers that the main threats to the property are deterioration in exposed and unused areas and extreme weather impacts. View lines are vulnerable to development pressure.

5 Protection, conservation and management

Boundaries of the nominated property and buffer zone
The nominated property boundaries enclose the interlinked watercourses used by Hydro and Tinfos AS for power production around 1920 from Møsvatn Dam to Heddalsvatnet Lake. Where the water runs through tunnels and pipes the boundaries follow the outside of these installations. Where the railway runs along the watercourses its outer boundary forms the property boundary. Where the boundary crosses Tinnsjøen Lake it includes the ferry route and lighthouses, but excludes the northern part of the lake. The towns of Rjukan and Notodden are included to the extent they covered in 1930.

The buffer zone covers the landscape of valleys in which the watercourses run and includes Møsvatn Lake, the Vestfjorddalen Valley, Tinnsjøen basin and valley down to

Heddalsvatnet Lake. It is bounded by the horizon as seen from the valley floor, or from vessels on Tinnsjøen Lake and includes the immediate setting of the property with all additional objects of "supporting value" as well as all important view lines.

ICOMOS considers that the boundaries of the nominated property and of the buffer zone are adequate.

Ownership

All attributes within the nominated property are privately owned except for the production equipment which is owned by the Municipality and the two railway lines and parts of Rjukan Hydro Town which are owned by the State. The buffer zone is almost all in private ownership, exceptions being some properties owned by the Municipality and the National road which is State-owned.

Protection

Cultural Heritage protection in Norway is largely the responsibility of the Ministry of Climate and Environment, through its Directorate of Cultural Heritage, which administers the Cultural Heritage Act 1978, amended 2009. It is also the responsibility of the County Council which cooperates with the municipalities in preparing master plans and zoning plans to ensure protection of Cultural Heritage of national or regional value under the Planning and Building Act 2009, amended 2012.

A table in the nomination dossier shows which attributes and their component parts are protected by The Cultural Heritage Act 2013. These include both Industrial Parks in total, and the whole Transport System except for Mælsvingen with five houses which are protected under the Planning and Building Act 1985. Of the Power Plants; Tinfos I & II, parts of Vemork and Såheim are protected under the Cultural Heritage Act, and other parts are protected by the Planning and Building Act or other general legislation not Heritage related. Only a few specific buildings in Notodden and Rjukan towns are protected under the Cultural Heritage Act, the remainder are protected under the Planning & Building Act or other general legislation. In response to ICOMOS' second letter and the telephone meeting, the State Party has provided a new timetable showing that all items will be protected by the Cultural Heritage Act or specific Heritage provisions of the Planning & Building Act by June 2015, together with supporting letters from the relevant authorities.

All objects with "supporting value" within the buffer zone are cultural Heritage sites and protected by the Cultural Heritage Act and/or the additional regulations of the Planning and Building Act. A further protective function is established by the zoning plans of the municipalities.

ICOMOS considers that the legal protection planned to be complete by June 2015 will be adequate. ICOMOS considers that the protective measures for the property are adequate.

Conservation

The thirteen nominated attributes of the property and their components have been inventoried in detail and their condition assessed according to the Norwegian Standard 3423 'Condition Survey of protected buildings and buildings with historical value'. Tables are provided in the nomination dossier, which show that conservation/ maintenance works have been undertaken, are underway or are planned where required. ICOMOS considers that the conservation measures are appropriate to conserve the property's values, integrity and authenticity.

ICOMOS considers that conservation is adequate.

Management

Management structures and processes, including traditional management processes

A 'Declaration of Intent' has been signed by the State Party and relevant county council and municipalities undertaking to protect the Outstanding Universal Value and the buffer zone. A provisional World Heritage Council comprising representatives from the Directorate for Cultural Heritage, the Telemark County Council, the three municipalities (Notodden, Tinn and Vinje) and the Norwegian Industrial Workers Museum has been set up to deliver a management structure for the property should it achieve World Heritage status. The Tinn and Notodden municipalities currently have one World Heritage coordinator each. If World Heritage status is achieved, a World Heritage Coordinator with responsibility for the whole area will be appointed. According to additional information provided by the State Party in response to ICOMOS' letter, the partnership agreement between Telemark County and the municipalities as a basis for setting up the permanent World Heritage Council was approved in June 2014, with a World Heritage coordinator as Secretary. It is proposed that the World Heritage Council will meet annually with central stakeholders, including the owners of companies within the Industrial Parks who may also participate in its ordinary meetings.

Meanwhile the attributes are managed by the County Council and municipalities under the Ministry of Climate and Environment and its Directorate for Cultural Heritage with input from various ministries and government agencies. The Directorate's staff includes specialists in relevant fields as does the staff of the County and Municipal authorities. Other expertise is provided by the Norwegian Institute for Cultural Heritage Research, three ship conservation centres and the Norwegian Industrial Workers' Museum. Funding is provided through the annual allocation to the Directorate for Cultural Heritage for work on World Heritage sites. The total for 2013 was NOK 60 million. Various other sources of funds are available to private owners and businesses. ICOMOS notes that the Management Plan does not include further risk preparedness measures said in the nomination dossier to be required – see Factors affecting the property above. However in response to ICOMOS'

second letter the State Party has provided further details of the risk preparedness measures which will be included in the Management Plan.

Policy framework: management plans and arrangements, including visitor management and presentation

A number of national, regional, county and local plans cover the nominated property area. The future major road crossing the site is mentioned above. This will be subject to relevant legislative controls. The Regional Plan for Tourism and Experiences 2011-24 adopted by the County Council 15 June 2011 provides funds for tourism projects that promote the application for World Heritage status in the period 2013-2016. The strategy for culture and cultural Heritage in Telemark will contain objectives and measures related to World Heritage. Long term priorities include increasing knowledge of cultural Heritage in the county and craftsmen training. Notodden local plans include conservation guidelines relating to cultural Heritage protection and a municipal emergency response plan. Tinn local plans focus on developing business and services opportunities in parallel with supporting World Heritage status.

The Management Plan has been prepared and was approved by the parties to the 'Joint Declaration of Intent' in 2013. An Action Plan is provided for 2014-2019. This includes goals and actions for conservation, strengthening of Outstanding Universal Value, competence building and research, information & presentation, and visitor management and will be reviewed in 2020. ICOMOS notes that as well as omitting the risk preparedness strategy, the Action Plan does not mention reactivating the Railway Line/Ferry system for tourism purposes, although it appears to be intended.

Involvement of the local communities

It is proposed in the Management Plan that the World Heritage Council will hold meetings with stakeholders, representatives of business and industry and voluntary organisations at least once a year.

ICOMOS considers that the current management system is effective.

In conclusion, ICOMOS considers that the management system for the property is adequate. The Management Plan should be extended to include a risk preparedness strategy as proposed in the State Party's additional information.

6 Monitoring

An outline for monitoring activities is provided in the nomination dossier with the division of responsibilities still to be determined by The Directorate of Cultural Heritage and the County and Municipal authorities. ICOMOS notes that detailed indicators are also yet to be defined. In response to ICOMOS' second letter the State Party has provided a more detailed outline of the monitoring programme to be included in the Management Plan. ICOMOS considers this needs to be further refined to relate to the inventory/data base of objects.

ICOMOS considers that the monitoring system will be adequate when it is further refined to relate to the inventory/data base.

7 Conclusions

ICOMOS considers that the comparative analysis justifies consideration of this property for the World Heritage List; that the nominated property meets criteria (ii) & (iv) and conditions of integrity and authenticity. The main threats to the property are deterioration in exposed and unused areas and extreme weather impacts. View lines are vulnerable to development pressure. The boundaries of the nominated property and of the buffer zone are adequate.

ICOMOS considers that the legal protection will be adequate when all proposed changes to the legislation are in place, which is expected to be by June 2015. ICOMOS considers that conservation is adequate and the management system for the property is adequate. The monitoring system needs to be further refined to relate to the inventory/data base.

8 Recommendations

Recommendations with respect to inscription

ICOMOS recommends that Rjukan-Notodden Industrial Heritage Site, Norway be inscribed on the World Heritage List on the basis of **criteria (ii) and (iv)**.

Recommended Statement of Outstanding Universal Value

Brief synthesis

Located in a dramatic landscape of mountains, waterfalls and river valleys, the Rjukan-Notodden Industrial Heritage Site comprises a cluster of pioneering hydro-electric power plants, transmission lines, factories, transport systems and towns. The complex was established by the Norsk-Hydro company which brought together results of science and research from Europe and North America to produce hydroelectricity and manufacture artificial fertilizer from nitrogen in the air in response to the Western world's demand for increased agricultural production in the early 20th century. Rjukan and Notodden company towns incorporated social innovations in workforce provision influenced by international planning ideas which together with innovative transport solutions enabled supply of a new, globally significant product for the world-wide market.

Criterion (ii): Rjukan-Notodden Industrial Heritage Site manifests an exceptional combination of industrial themes and assets tied to the landscape, which exhibit an important exchange on technological development in the early 20th century.

Criterion (iv): The technological ensemble of Rjukan-Notodden comprising dams, tunnels, pipes, power plants, power lines, factory areas and equipment, the company towns, railway lines and ferry service, located in a landscape where the natural topography enabled hydroelectricity to be generated in the necessary large amounts stands out as an example of new global industry in the early 20th century.

Integrity

In general all important remaining physical structures and objects that are testimony to the industrial pioneering period of the production of artificial fertilizer for agriculture in Norway in the early 20th century are within the boundaries of the nominated area which is of adequate size to ensure the complete representation of the features and processes which convey the property's significance. The physical fabric of the property and its significant features are generally in a good condition. The property is not suffering from adverse effects and neglect.

Authenticity

The property incorporates buildings, structures and remains which convey credibly and truthfully its Outstanding Universal Value as a pioneering industrial enterprise for the production of artificial fertilizer in the early 20th century.

Management and protection requirements

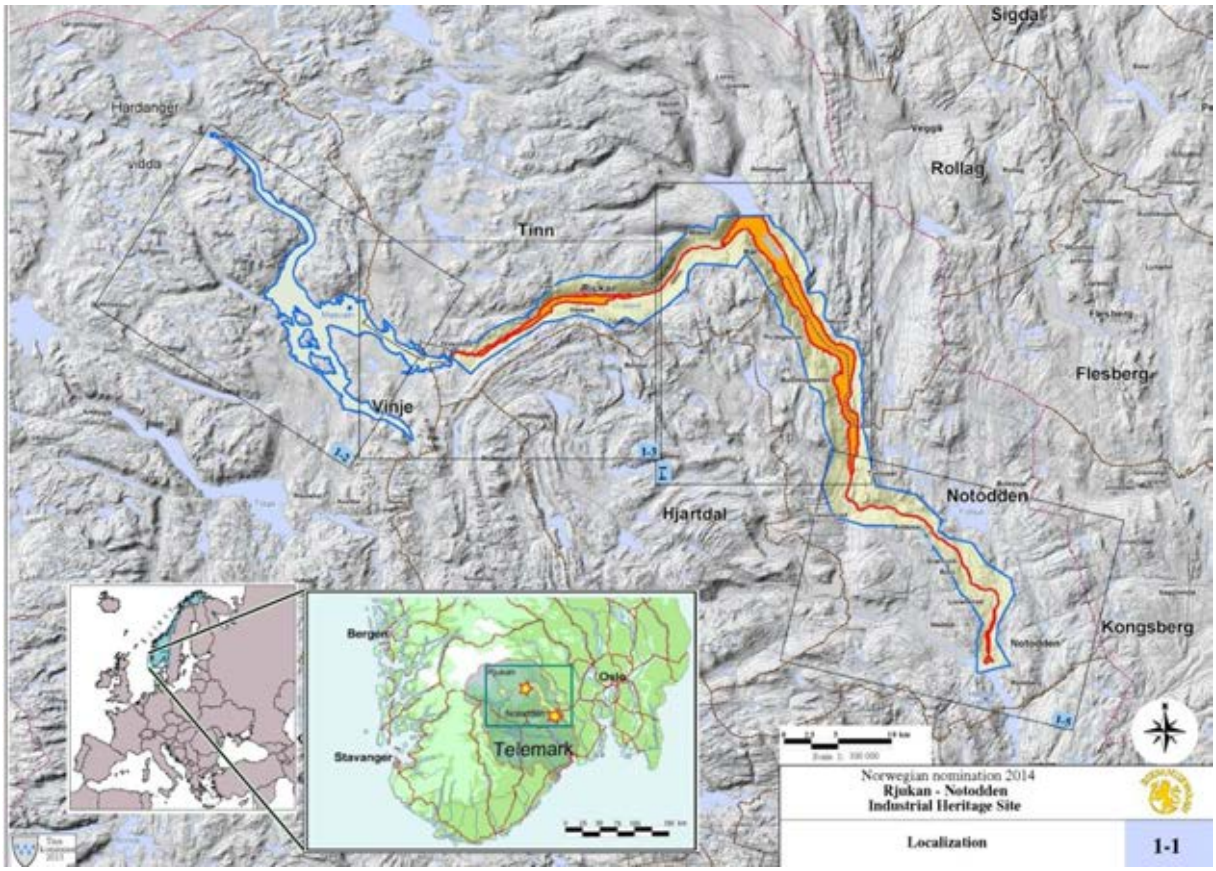
The property is protected under the Cultural Heritage Act 1978, amended 2009 and the Planning & Building Act 2009, amended 2012. All specified items will be protected by the Cultural Heritage Act or specific heritage provisions of the Planning & Building Act by June 2015. The buffer zone is protected under the Cultural Heritage Act and zoning controls pursuant to the Planning & Building Act.

A 'Declaration of Intent' has been signed by the State Party and relevant county council and municipalities undertaking to protect the Outstanding Universal Value and the buffer zone. A provisional World Heritage Council comprising representatives from the Directorate for Cultural Heritage, the county authority, municipalities and the Norwegian Industrial Workers Museum has been set up to deliver a management structure for the property. A World Heritage Coordinator with responsibility for the whole area will be appointed. The Management Plan 2014-2019 includes an Action Plan with goals and actions for conservation, strengthening of Outstanding Universal Value, competence building and research, information & presentation, and visitor management and will include a risk preparedness strategy.

Additional recommendations

ICOMOS recommends that the State Party give consideration to the following:

- Extending the Management Plan to include a risk preparedness strategy as proposed;
- Refining the Monitoring System to relate to the inventory/data base.



Revised map showing the boundaries of the property

Tinfos II Power Plant

Såheim Power Plant

Notodden, Hydro Industrial Park

Rjukan, Hydro Industrial Park