

Non-technical Summary

I. Introduction

This draft Comprehensive Environmental Evaluation (CEE) report aims to establish a plan that will minimize the adverse impact of the construction and operation of a new Korean research station in Antarctica. Comprehensive analyses on the environmental impact have been carried out in order to ensure that the station can be operated in a sustainable manner with minimal impact on the environment.

Considering the research programs including international collaboration, convenience of logistics, and its impact on the local environment, the site of Jang Bogo Antarctic Research Station (74°37.4'S / 164°13.7'E) was chosen through an evaluation process of six candidate sites in the Antarctic region from 2007 to early 2010. The proposed site is located near Cape Möbius, the coastal area of Terra Nova Bay in Northern Victoria Land along the Ross Sea.

The main purpose of Korean Antarctic research is parallel to the international efforts on predicting global climate change process through multidisciplinary research. As an independent station that will operate year-round, the Jang Bogo Station will develop the West Antarctic observatory network with Korea's King Sejong Station and the icebreaker *ARAON*.

The key scientific programs based on the Jang Bogo Station include:

- Climate and atmospheric chemistry

A WMO/GAW Global Station will be installed at the Jang Bogo Station. In connection with other stations in Antarctica, this large-scale monitoring of atmospheric components will cover the entire Antarctic region to strengthen the understanding of the interactions between the polar region and middle latitude of the southern hemisphere.

- Glaciology and snow chemistry

Studies of snow and glaciers along the coast of West Antarctica will be conducted at the Jang Bogo Station as well as supported by the icebreaker *ARAON*, contributing to restoring the paleo-climate and paleo-environmental changes of the Pacific margin of Antarctica.

- Tectonics and geophysics

As various forms of glaciers developed near the proposed site, long-term monitoring of movement and mass balance of glaciers will be carried out in order to comprehend the relationship between tectonics and glacial changes. In addition, seismic, geomagnetic and GPS observation systems will be installed at the Jang Bogo Station as a part of the Polar Earth Observing Network (POLENET).

- Long-term monitoring for ocean and ecosystem

The Jang Bogo Station will accommodate year-round monitoring and research of the long-term impacts of climate change to ecosystem of the surrounding areas. A long-term monitoring program will be established in order to identify the major oceanographic and atmospheric parameters that are responsible for the rapid freshening in the Ross Sea.

II. Description of the Proposed Activity

The proposed site for the Jang Bogo Station is located on a small cape approximately 1.2km NNE of the Cape Möbius where Germany's Gondwana Station is located.

The main activities dealt with in the draft CEE include: construction, operation, and dismantlement of the station; installation and use of temporary facilities during the construction; and transportation of supplies and personnel to the station. The construction is planned to start in December 2012 and continue for two years during the Antarctic summer season. The station will begin to operate early 2014.

The station includes the main building, research facilities, and maintenance and operation facilities with a building area of 3,826.9m². The station is planned to be used for no less than 25 years. It will accommodate up to 15 personnel in the winter and up to 60 personnel in the summer.

The main building is designed to be an aerodynamic triple-arm structure elevated from the ground surface. The main building will work as the central hub, with other facilities being arranged like the spokes of a wheel. This type of layout is known to be reliable, has high functionality and efficiency, and causes minimal damages to the surrounding land. Moreover, the layout will minimize access time between buildings since all facilities will be directly accessible to the main building. The main building is designed to withstand strong winds and fire. The compartmentation in the building will help prevent fire from spreading, and the stable aerodynamic structure will provide increased resistance against strong winds. Furthermore, the combination of the elevated and slanting structures helps to

minimize the amount of snow pile-up around the building.

In an effort to minimize the construction period, a modular construction system will be adopted. The modular construction system will not only shorten the construction period but also minimize the number of workers required and construction wastes. This will also facilitate future dismantlement.

The use of Combined Heat and Power (CHP), solar and wind renewable energy, and waste heat will cover 100% as energy sources, thereby reducing the use of fossil fuels while the station is in operation. A state-of-the-art comprehensive treatment system will be installed and operated in order to prevent waste and wastewater from affecting the clean Antarctic environment. The basic operation principle will be thorough management and storage of wastes, and treatment and removal them off the Antarctic. In case of incineration, a flue gas recirculation which minimizes the emission of pollutants by high temperature combustion will be used. Furthermore, the wastewater will be reused as much as possible by using the gray water reclamation and reuse system, and ultimately, will be treated and discharged with almost no pollutant.

III. Alternatives to the Proposed Activity

Various alternatives including no-action to the proposed activities have been compared and reviewed to select the best option in terms of the comparability of the site as well as for the design of the station.

Several alternatives examined to the proposed activities include:

- No-action alternative
- Six alternative locations in Antarctica (two in West Antarctica and four in East Antarctica)
- Three alternative locations in Cape Möbius region
- Three alternative designs of the main building
- Three alternative wind turbine types
- Five alternative means of transport (two for air transportation and three for marine +land transportation)

The proposed site was selected considering not only its compatibility in construction and operation, but also the research areas that Korea is planning. Minimizing any impact which the station would have on the natural environment was also considered.

For the main building, intensive triple-arm shaped design was selected because it is known to respond reliably to the extreme weather conditions of the Antarctic region, while maximizing energy efficiency, and could be operated year-round.

The vertically stacked modular type structure was selected for the final design of the wind turbine considering efficiency of power generation, noise, maintenance ease, and impacts on the ecosystem.

Marine transportation was selected over air transportation as the best means of transportation in consideration of cost, convenience, and on-time performance under uneven weather conditions.

IV. Initial Environmental Reference State of the Terra Nova Bay Region

The Terra Nova Bay region where the Jang Bogo Station will be located is one of the most biologically and ecological diverse regions in Antarctica. It is a habitat to a diverse number of species, namely bryophytes, lichens, sea birds, and invertebrates. However, the colonies and habitats of major bio-species do not exist close to the proposed site.

The wind speed at Cape Möbius region is extremely high and variable. Strong westerly wind can reach a maximum speed of 56.4m/s. According to the previous long-term observatory data produced by Italy's Mario Zucchelli Station, the annual average temperature of the regions is -14.1°C, and the annual average wind speed is 6.4m/s. According to the results of the data analysis by AWS (Automatic Weather System), northwesterly winds, together with westerly winds, develop at the proposed site predominantly due to topographical controls.

The proposed site is located in a small cape that is mainly composed of exposed bedrocks and glacial moraines. Most of the land gently slopes close to the coast.

Regional studies on flora and fauna show that only a few kinds of species inhabit the area. About 26 species of vegetation, primarily lichens and mosses, exist near the freshwater pond, approximately 1.2km north of the proposed site. A population of Weddell Seals was observed on an ice field near the proposed site and a colony of South Polar Skua was located in the east of Germany's Gondwana Station.

There are three Antarctic Specially Protected Areas (ASPA) and two Historic Sites and Monuments (HSM) in the vicinity of the Cape Möbius region.

V. Prediction of Impacts, Assessment and Mitigation Measures of the Proposed Activities

An impact assessment of the construction and operation of the station on the Antarctic environment was conducted through comprehensive analyses of the proposed activities based on the data acquired during the survey and accumulated knowledge on natural environment and weather conditions of the region provided by Italy and Germany. In addition, the environmental impacts caused by the construction and operation of the station were estimated for the major factors such as emissions of air pollutants, potential fuel and oil leakage, waste and wastewater, and noise generation, and ecosystem. Optimal mitigation measures to reduce them were established accordingly (see section II in the above).

The main environmental impacts possibly caused by the proposed activities include:

- Unavoidable atmospheric emissions involved with fuel consumption
- Possibility of fuel and oil spills during fuel transfer and refueling as well as from damaged fuel pipelines and tanks
- Generation of hazardous and non-hazardous wastes such as construction waste, domestic waste, waste oil, and food waste
- Wastewater generation during the construction and operation of the station
- Noise generated from loading and unloading activities, equipment operations and other activities
- Possibility of disturbance to the local ecosystem of both marine and land biota (e.g., colonies of Weddell Seal and South Polar Skua, and lichens and mosses)

Waste heat from CHP system will be used to reduce the emissions of air pollutants. The use of fossil fuels will be minimized by increasing renewable energy and maximizing the indoor use of natural sunlight, and recycling the waste heat.

To prevent fuel spills, fuel tanks will be double-skinned and oil impermeable bund wall will be built around the fuel tank. For prevention and clean-up of spills, appropriate equipments and supplies will be prepared in the station in accordance with the associated regulations such as the guidelines of COMNAP/SCALOP (2003), etc.

Waste will be managed according to the guidelines for waste management in the Antarctic. All wastes will be sorted, safely stored and removed out of Antarctica for recycling or disposal.

Wastewater will be treated using the comprehensive state-of-the-art treatment system. The treated water up to the most stringent level of wastewater standards will be discharged (e.g.,

BOD less than 5 mg/ℓ and COD less than 20 mg/ℓ) accordingly.

Even at full-capacity operation of heavy equipment during the construction, the estimated noise levels do not significantly affect the colonies of South Polar Skua and Weddell Seal, located approximately 1 km away from the proposed site.

Given that there are no habitats or colonies of major bio-species close to the proposed site, the station will not cause a significant impact on the surrounding ecosystem.

Environmental impacts and mitigation measures are summarized in an impact matrix, which evaluates possibility, range, period, and importance of the impacts.

VI. Environmental Monitoring and Verification

The Jang Bogo Station will implement an environmental monitoring program to continuously monitor environmental changes caused by its operation, and prepare systematic mitigation plans to respond to environmental accidents and other emergency. Activities that adversely affect the environment will be investigated and adjusted through monitoring of air emissions, fuel leakage, wastewater treatment, waste management, and the ecosystem.

VII. Gaps in Knowledge and Uncertainties

The uncertainties and gaps in knowledge identified in the draft CEE for the construction and operation of the Jang Bogo Station are as follows:

- Distribution of sea ice around Cape Möbius and climate conditions during construction period
- Future retreat of the Campbell Glacier Tongue near the proposed site
- Long-term climate change near the construction site
- Uncertainties in the knowledge and information of natural environment near the proposed site
- Status of a few South Polar Skua nests distributed close to the proposed site
- Final design and layout of the facilities
- Minor changes in the application of various techniques and methods of construction and operation

- Items related to the future expansion of the station
- Changes in the activities of the station according to the change in future perspectives of research

VIII. Conclusion

The environmental impact of the construction and operation of the Jang Bogo Station is anticipated to be minimized by applying environmentally friendly technologies and optimal scientific mitigation measures. In addition, impacts of activities related to research and maintenance/management of the station on the ecosystem are also expected to be reduced by proper mitigation measures. The South Polar Skua colony near the proposed site is located at a safe distance from the station, and hence, the disturbance to skuas will not be significant by the construction and operation of the station.

The Jang Bogo Station will be a multidisciplinary research hub of this region. It will fulfill its role of contributing to the international and multidisciplinary research activities by providing support not only to Korean scientists, but to foreign scientists and giving opportunities cooperating on international science projects.

The result of CEE suggests that the profits of knowledge and scientific information that will be obtained from the Jang Bogo Station will grossly outweigh the “more than a minor or transitory” impact on the Antarctic environment; thus, the establishment of Jang Bogo Station is highly recommended.