

**Publication of the third-party committee's report on survey of the location conditions for a futuristic medium size (3-GeV) synchrotron light facility with high brilliance (also called Synchrotron Light in Tohoku, Japan (SLiT-J))**

**Abstract:** On 22nd June 2015 the third-party committee, established under the Coordination Subcommittee of the Council for the Promotion of a new Tohoku Synchrotron Light Facility, has published the investigation report. The sites were examined from the perspective of good traffic accessibility and sufficiently good bedrock against vibration including small shakes caused by earthquakes. Three candidate sites proposed by Marumori-Town, Matsushima-Town and Ohsato-Town in Miyagi prefecture have satisfied the required conditions.

**Members of the third-party committee:** [Coordination Subcommittee of the Promotion of a new Tohoku Synchrotron Light Facility (SLiT-J)]

Dr. Noritaka Kumagai, Executive Advisor (JASRI/Spring-8) *Chair*

Dr. Yoshiyuki Amemiya, Professor (The University of Tokyo) *Co-Chair*

Dr. Sin-ichi Adachi Professor (Institute of Materials Structure Science, KEK)

Dr. Wataru Ustumi, Director General (Kansai Photon Science Institute, JAE A)

Dr. Shunji Goto, Division Head (JASRI/Spring-8)

Dr. Nobuhiro Kosugi, Professor (Institute for Molecular Science )

Dr. Kenji Suzuki, Executive Director (Research Institute for Special Inorganic Materials)

Dr. Yasuharu Hirai, Director (Kyushu Synchrotron Light Center)

Dr. Jun'ichiro Mizuki, Professor (Kuwasei University)

[Names in Japanese alphabetical order]

**Council for the Promotion of a new Tohoku Synchrotron Light Facility,**

Dr. Hiroyuki Hama, Professor (Tohoku University,LES) *Chair*

Dr. Masaki Takata, Professor (Tohoku University, IMRAM) *Co-Chair*

Dr. Yoshio Waseda, Emeritus Professor of Tohoku University, *Corresponding secretary:*

(E-mail: [waseda@tagen.tohoku.ac.jp](mailto:waseda@tagen.tohoku.ac.jp); Phone: 81-22-217-5166 )

Synchrotron Light in Tohoku, Japan (SLiT-J) is designed to provide high-flux soft X-rays of the order of  $10^{20}$  (photons/s/mrad<sup>2</sup>/mm<sup>2</sup>/0.1%bw) suitable for "Nano-beam applications" of less than 10 nanometer. Therefore SLiT-J can certainly be considered as one of the most advanced facilities in the world. In order to obtain the best performance of SLiT-J, sufficiently good bedrock against vibration including small shakes caused by earthquakes is essential at the required location of SLiT-J facility. Such location condition is also required for many electromagnets for optimum performance.

The synchrotron light facility is very widely used for producing industrial innovations and challenging applications in the academic sector. It is well understood that the synchrotron light facility is a basic and necessary infrastructure for giving better solutions and sophistication for advanced industrial products. This is a global trend. Therefore, it is easy to anticipate that performance of the 3GeV synchrotron light source with high brilliance will attract a large number of industrial users. Hence, good connectivity and accessibility for both Japanese and overseas users to SLiT-J is one of the important conditions for selecting a good location. The location should also have good capability and capacity to ensure future development and collaboration among many groups including companies around SLiT-J.

Considering these important factors of the location of SLiT-J, we carefully and fairly examined the information including geological data, boring data and traffic accessibility *etc.* of six candidate sites that were kindly provided to the office secretariat of the Council for the Promotion of a new Tohoku Synchrotron Radiation Facility. The following conclusions were obtained after doing site tours of three sites.

1. Sufficiently good bedrock, that is solid ground consisting of granite not susceptible to weathering, is found in the candidate site at Marumori town. It has been identified in the that The level of seismic intensity of Marumori area was recorded as "upper 5" on the Japanese seven-stage seismic scale during Great East-Japan Earthquake on 11 March 2011. This is lower than the seismic intensities ("lower 6") (see #) detected in peripheral provinces by 1 or 2 ranks. The ground of Marumori area is found to be strong against vibration. Thus, the site proposed by Marumori town is considered to be optimal as a physical element required for the advanced synchrotron light source with high brilliance for precise control of nanometer-size beam. In addition, it is noted that Marumori town has good cooperative networks with four cities and nine towns in the southern part of Miyagi prefecture and as well as seven municipalities in Fukushima prefecture. Such collaboration over the prefectural boundary is conducive for future investments and development.

To avoid cracks explosive blasting cannot be used for preparation of rock ground of synchrotron light facility site. Because rock excavation work has to be conducted mainly by heavy machines there would be an increase in construction costs. In hillocks, the cut soil part in mountain-side also requires augmentation for prevention of landslides and it automatically leads to increased cost. The quarry produced by digging can be used for construction works of the area damaged by the Great East-Japan Earthquake with huge Tsunami, but this requires budgetary assessment by Marumori municipal office and regional governments.

2. The candidate sites at Matsushima town and Ohsato town are considered to be suitable for synchrotron light facility from the geological point of view, because these two candidates are found to have a ground consisting of pumice tuff, soft to medium-hard rocks or light sandstone topographically. However, it is to be noted that significant excavation will be needed to reach a stable layer, groundwater level information is unclear, solid pumice stone, tuff or light sandstone have concerns regarding brittleness even if it is rigid. In addition, the level of seismic intensity of Matsushima and Ohsato area was recorded as “lower 6”, so that it may be a nuisance for nano-beam application of SLiT-J. Additional construction costs should be needed for substantially reducing the hassle.

On the positive side, these two candidate sites are located near expressway interchanges and traffic accessibility from surrounding prepared industrial parks and the famous tourist spot with many hotels (Matsushima) is very good.

3. From the view point of traffic accessibility, it is rather difficult to find any significant difference in these three candidate sites of Ohsato town, Matsushima town, and Marumori town in Miyagi prefecture. Specifically, it takes approximately 2 hours and 30 minutes from Tokyo JR Station through Sendai JR station to reach to Ohsato and Matsushima by railway coupled with vehicle to site; 2 hours and 50 minutes in case of Marumori. Note that it takes about 2 hours and 30 minutes from Tokyo JR station to Marumori, when using Shiroishi-Zao JR station and vehicle. From Sendai Airport using rent-car service it takes about 40 minutes to reach all three candidate sites. These three sites are found to have much more favorable traffic accessibility compared to Harima (Spring-8) which takes about 5 hours to reach from Tokyo JR station. Of course, we would like to recommend some further improvement of the road conditions, straightening and widening of roads.

Although public accommodations are available near the sites at Ohsato and Marumori,

no significant difference is found in three candidate sites including Matsushima since many hotels are available in nearby area. Good support from nearby community residents is expected in all three cases, because the regional officers of three towns provide the information about the usefulness of SLiT-J project and related merits and demerits through public meeting with people around the construction sites. The third-party committee carried out site-tours for three candidate sites of Ohsato, Matsushima and Marumori (**see photographs**). Then it was noted that the territorial owner (private company) has already begun land development in Matsushima town, corresponding to the candidate site of SLiT-J. Hence, antecedently arrangement is suggested in the Matsushima case.

### **(#) Seismic intensity scale described by the Japan Meteorological Agency**

Ten-ranks of 0, 1, 2, 3, 4, lower5, upper5, lower6, upper6 and 7 are provided and these ranks are different from the so-called Richter scale with “magnitude” widely used in many countries. Note that Great East-Japan Earthquake on 11th March 2011 registered “magnitude of 9.0” and the seismic intensity of 7 or upper 6 on the Japanese scale registered in many parts of Miyagi and Fukushima prefectures. This earthquake also registered an seismic intensity of upper 5 in some parts of Tokyo.

**lower5:** Most people are seized with fear and try to hold onto something.

**upper5:** Most people find it difficult to walk without holding something.

**lower6:** Difficult for people to stand.

**upper6:** Impossible for people to move without crawling.

## **Reference**

### **Main service of third-party committee**

Before starting the activities of the third-party committee, members set the following three main goals:

1. Survey and investigation of a sufficiently good location for a futuristic medium size (3-GeV) synchrotron radiation facility with high brilliance should be done fairly on scientific basis.

2. All available data for candidate sites are collected even if they are unofficial. Fair comparison should be carried out by applying the location conditions as required of a public facility such as SLiT-J. A field investigation is also to be conducted, if needed.
3. As a result of undertaking the above cited processes, we would be happy if some remarks regarding the candidate sites for SLiT-J can be obtained.

In addition, the resultant summary is to be published and reported to three co-representatives of the Promotion Association of the SLiT-J project in Tohoku Area. Note that all necessary supporting works to the third-party committee shall be arranged by Council for the Promotion of a new Tohoku Synchrotron Radiation Facility, (*Chair*; Professor Hiroyuki Hama).

The following six locations were investigated by the committee. Many thanks are due to all persons who kindly prepared and submitted valuable information including geological data, boring data and traffic accessibility *etc.*

1. Matsushima Town, Miyagi-County, Miyagi Prefecture
  2. Ohsato Town, Kurokawa-County, Miyagi Prefecture
  3. Mutsu-Ogawara New Energy Industrial Complex, submitted from Aomori Prefectural office, Aomori Prefecture
  4. Marumori Town, Igu-County, Miyagi Prefecture
  5. Yonezawa-Hachimanpara Core Industrial Complex, submitted from Yamagata University, Yamagata Prefecture
  6. Aobayama-New Campus, submitted from Tohoku University, Miyagi Prefecture
- [Names in the order of arrival]

The committee made a site-visit to the following three locations on June 10<sup>th</sup>, 2015.

1. Ohsato Town, Kurokawa-County
  2. Matsushima Town, Miyagi-County
  3. Marumori Town, Igu-County
- [Names in the visiting order]

*Photographs of this site-visit*

### **Selected points for considering the location conditions**

Points for discussing the location conditions of SLiT-J facility are considered to be important for an impartial judgment with scientific basis. Therefore, the committee members discussed such points by E-mail and they were finalized through their deliberation at the first committee meeting. The essential points are as follows..

1. **Physical element** required to build Synchrotron Light Facility consisting of "Linear electron injector" and "Electron Storage ring":

- (1) Sufficiently rigid bedrock against vibration including small shakes caused by earthquakes.
- (2) Geographical and topographical features inclining the land slope characteristics because it may affect design and construction of linear electron injector etc.

2. Location for synchrotron light facility

- (1) Proposed site and offered area (Map and drawing are requested)
- (2) Future development plans (including other projects besides synchrotron light facility)
- (3) Information of infrastructure improvement for roads, electrical power, waterworks (current status/scheduled for execution)

If they are to be newly prepared , will the works be done by the local governments or by the private sector.

3 .Affiliated plans with space such as science city/ research complex/ new business/ new research institutions, etc.

- (1) Current status
- (2) Future plan (if any)

4. Present situation whether the SLiT-J project is well-understood by the local residents near the site and whether they can executed successfully.

5. **Traffic accessibility** (One of the important points, because many people will come to use the advanced facility of SLiT-J)

- (1) Time required from Tokyo JR station to the corresponding location (Train and automobile) or Time required from Sendai airport (Train and automobile).
- (2) Public transportation between neighboring major train station and the corresponding location. Information with frequency should be included,
- (3) Availability and capacity of accommodation for the facility users. Is

accommodation available in the close vicinity to the corresponding location?

If they are to be created in the future, will it be done by the local governments or by the private sector.

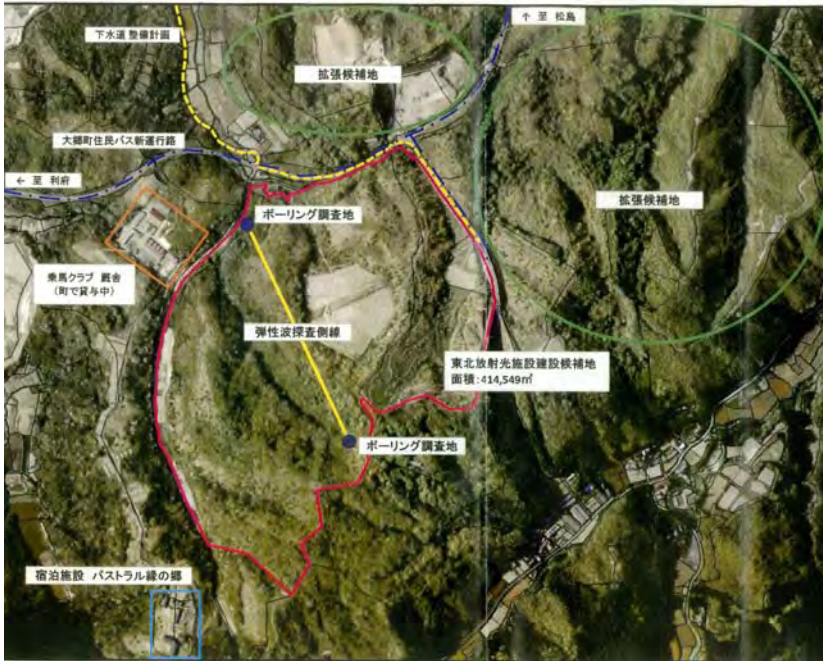
#### 6. Others

- (1) Relationships with the location conditions for effectively contributing to upgrading of primary industries including agriculture, forestry, stockbreeding and fishing.
- (2) Climate, annual sunshine hours etc. (estimated generation amount in case of performing photovoltaic power generation; solar-cell),
- (3) Weather conditions of wind and snow (estimated possible construction period, particularly, snow cover period and amount of snowfall)
- (4) If the sufficiently rigid bedrock is not available in the corresponding site, estimated cost for mitigating this problem should be given,
- (5) Any other noteworthy points may also be given, if needed.

**Supplement:** Importance of sufficiently rigid bedrock was again stressed in the process of committee discussion, because not only nano-beam application but also the vacuum sealing undulator device are very sensitive to vibration including small shakes caused by earthquakes. As kindly suggested by Dr. Hideo Kitamura, inventor of "the vacuum sealing undulator device" which is necessary for the SLiT-J facility, there are stringent vibration restrictions.



東北放射光施設 大郷町候補地周辺計画図





# Matsushima

