# Panel Report:

# Results of the Panel Review on the Circumstances and Causes of the Diving Incident at the Ie-suido Channel and Recommendations for the Prevention of Similar Incidents

This report is based on the evaluation and review by the External Review Panel of the OIST Diving Incident on their own responsibilities based on their analysis and examination of materials collected by the Panel. It does not necessarily represent opinions and views of OIST. Panel Report:

Results of the Panel Review on the Circumstances and Causes of the Diving Incident at the Ie-suido Channel and Recommendations for the Prevention of Similar Incidents

May 10, 2017

External Review Panel of the OIST Diving Incident

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#### Prefatory note

The OIST Review Panel of the Diving Incident (hereinafter, "Panel") was established in January 2017 by request from Dr. Jonathan Dorfan, the then President of Okinawa Institute of Science and Technology Graduate University (hereinafter, "OIST"), with its mission to identify causes of the diving incident in which an OIST Diving Worker went missing during diving operation at the le-Suido channel off the coast of Motobu-cho, Kunigami-gun, Okinawa on November 14, 2016, and establish measures for preventing any similar incidents from occurring. At the establishment of the Panel, only external experts in the relevant fields were appointed as the Panel members for ensuring objectivity of the meetings, and they worked to identify not only immediate causes but also as many root causes as possible and to make recommendations for preventing any similar incidents from occurring.

The Panel consisted of Dr. Hitoshi Yamamoto who served as the Chair and other 5 external experts. The Panel invited three external advisors to the Panel meetings, to be provided with information to facilitate the understanding of technical issues. This Report of the Panel of the Diving Incident (hereinafter, "Report") has been formulated based on the substance of the five Panel meetings: investigations conducted by the members, analysis of collected information, details of committee deliberations, and recommendations for preventing similar incident derived from these.

In addition, in order to ensure objectivity of the meetings, deliberations of the Panel were carried out solely by the external members, absolutely no presence of people affiliated with OIST.

The Report consists of the following six chapters:

Chapter 1, which briefs the Guidelines for the Panel, the Panel members, and the Panel meeting schedule and main agendas;

Chapter 2, which provides a summary of the diving incident focused on factual findings, including the purpose of the diving work, the chronology of the incident, searches after the occurrence of the incident, and responses of the administrative offices such as the Japan Coast Guard and the Labor Standards Inspection Office, etc.;

Chapter 3, which provides results of the investigation of the diving work led to the incident and inquiry for information, and an analysis thereof from the experts' point of view;

Chapter 4; which provides a summary of results of the investigations and

deliberations on the underlying factors which eventually led to the incident, focusing on such aspects as the governance of OIST, the safety and health management system, the system of research assistance sections, and the conditions of the diving workers;

Chapter 5, which provides comprehensive analyses of the diving work and the underlying factors, and reviews the whole picture of the diving incident; and Chapter 6, which proposes, in view of the review of the diving incident, improvements that should be addressed by OIST for the prevention of similar incidents in the future, and the Panel's recommendations of measures for the prevention of similar incidents.

# 1. Descriptions of the Panel

# 1.1 Guidelines for an OIST Review Panel of the Diving Incident

# Guidelines for an OIST Review Panel of the Diving Incident

# Mission and Term

 An OIST Review Panel (hereinafter "Panel") shall be established in order to review the circumstances and cause(s) of the diving incident that occurred at le-suido on November 14, 2016. The Panel shall be tasked with recommending future marine research safety measures to the OIST CEO/President, so as to prevent a recurrence of this incident. The Panel shall continue, with the end of April 2017 as a target, its work until it deems that its mission is complete.

# Membership of the Panel

- 2. Panel members shall be unaffiliated with OIST.
- 3. Panel members shall have, up to 6 in total, expertise in diving, research safety, pertinent law, and other professional capacities necessary for fulfilling the Panel's mission.
- 4. The CEO/President shall appoint members to the Panel who are recommended by the Dean of Research.

# Chair of the Panel

- 5. The CEO/President shall appoint the Chair of the Panel from among its members.
- 6. The Chair shall appoint an Acting Chair, who will act in behalf of the Chair, if the Chair is unable to fulfill his or her responsibilities.

# Advisor

- 7. With prior written notice to the Occupational Health and Safety Section, the Panel may invite advisors to provide professional or technical information or other advice as appropriate.
- 8. Advisors may be invited to attend Panel meetings or participate by teleconference, as appropriate.

# Establishment

9. The Panel shall commence its work as soon as it is established.

# **Panel Meetings**

- 10. The review and discussions will be conducted by meetings of the Panel.
- 11. Panel Meetings shall be convened and conducted by the Chair.
- 12. A Panel meeting shall not transact business unless a quorum of at least two-thirds of Panel members (including the Chair) participate in the meeting, either in person or by teleconference. If there is not a quorum, the Panel may discuss, but may not transact official business.
- 13. The Panel shall produce a report on their work including findings and recommendations. The findings may include reports of individual opinions, but the recommendations on marine research safety shall be made unanimously by the whole Panel. If this is not possible, these can be made by a majority vote, but dissenting opinions shall be recorded.

# **Review Parameters and Outside Cooperation**

- 14. The Panel may interview individuals who were at the incident site when the incident occurred. It may also interview their supervisors and any other individuals who may be able to furnish useful information.
- 15. OIST personnel shall cooperate with requests from the Panel and shall act in good faith. The Panel may request through the General Counsel, any information held by the Japanese Coast Guard, Police, Fire Department, Labor Standards Inspection Office, etc., if necessary.
- 16. The Panel shall review and consider pertinent laws, institutional rules, and procedures.
- 17. The Panel shall deliver its report including its findings and recommendations to the CEO/President upon completion of its mission. These findings and recommendations will be made public by OIST.
- 18. The Panel shall have an Email address so that any person at OIST can send information directly to the Panel that he or she believes is germane to the review.

# Remuneration of Panel Members for Travel Expenses

19. Panel members and advisors shall be remunerated for travel expenses, consistent with OIST Rules.

# Protection of Information

- 20. When personal information is requested by the Panel it will be provided as appropriate by those professionals who have custody of such information.
- 21. Panel members shall sign a Written Acceptance of

Appointment/Confidentiality Pledge.

Secretariat

22. The Secretariat of the Panel shall be provided by the Occupational Health and Safety Section, at OIST.

Effective from December 19th 2016

#### 1.2 Composition of the Panel

(1) Members

(Chair) Hitoshi Yamamoto

(Members; in random order)

- Akio Hashimoto: Diving expert; Chair of the "High Pressure Ordinance Technical Review Committee" of Nihon Sensui Kyokai (Japan Dive Association); Advanced Underwater Technical Advisor of The Nippon Salvage Co., Ltd.; Representative of High Pressure Work Assistance Office
- Fujio Koyama: Research safety expert; former member of the University of Tokyo Emergency Task Force for Diving Work Accident; former Deputy-Director-General of and Special Mission Professor at the Division for Environment, Health and Safety, the University of Tokyo; Visiting Fellow at Environmental Science Center, the University of Tokyo; Part-time Lecturer at Tokyo Institute of Technology; Grant-in-Aid Researcher, Graduate School of Environment and Information Sciences, Yokohama National University)
- Hitoshi Yamamoto, Research safety expert, Professor and Deputy Director of Safety and Health Management Department of Osaka University, Vice-President of Research for Environment, Health and Safety Education
- Masaharu Shibayama, Diving safety expert, Professor Emeritus at Komazawa Women's University, Adjunct Lecturer at Tokyo Medical and Dental University
- Mitsuo Taira, Diving expert, Occupational diver, President of Ocean Works Asia Okinawa, Inc.,

Naoko Miyao, Attorney-at-law, Plaza Law Firm

# (2) Advisors

Hiroshi Fujimoto, President of Umi to Shizen no Taiken Gakushu Kyokai

Tatsuya Nagayosi: Ryukyu Suinan Kyusaikai (Life-savers' Association)

Yukio Murata (Divers Alert Network Japan)

<ul> <li>(1) Summary of the Panel meetings and main agendas</li> <li>1st Meeting : Wednesday, February 15, 2017</li> <li>Hearing from concerned people (briefing of the incident)</li> <li>From the designing of the research plan to the occurrence of the incident</li> <li>Assistant Professor A</li> <li>Diving Worker B</li> <li>From the beginning of post incident responses to the</li> </ul>
1st Meeting       : Wednesday, February 15, 2017         Hearing from concerned people (briefing of the incident)         From the designing of the research plan to the occurrence of the incident         Assistant Professor A         Diving Worker B         From the beginning of post incident responses to the
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establishment of Emergency Task Force
Employee C (Occupational Health and Safety)
Information gathered before the panel meeting
(Chair Yamamoto's report)
Hearing from concerned people (for understanding of
the incident events)
Vise-president D (then Human Resources)
(Observer) Employee E
About invitation of advisors to the Panel meetings
2nd Meeting : Thursday, March 2, 2017 *with advisors
Hearing from concerned people
Ship Crew F (Captain)
Ship Crew G (of the research unit)
(Confirmation by e-mail)
Person from a company which engaged in the
search activity H
Ship Crew I (of the research unit)
Diving Equipment Vender J
Explanation of occupational diving (by Panel Member
Hashimoto)
Discussion
3rd Meeting : Friday, March 3, 2017
Hearing from concerned people
Vice President K (for research)
Employee C
Faculty L

	Assistant Professor A
R	eport of hearing from concerned people (by Chair
Ya	amamoto, Panel Member Miyao)
D	iscussion
4th Meeting : Fr	iday, March 24, 2017
*Partially, wit	h advisors
Н	earing from concerned people
	Diving Worker B
	Assistant Professor A
D	iscussion
5th Meeting : Fr	iday, April 7, 2017
R	eport of recovered equipment deployed in the sea of
th	e incident area (Chair Yamamoto, Secretariat)
F	ormulation of recommendations
(2) Record of other activ	/ities by the Panel members
February 1, 2017	: Meeting with parents of Diving Worker M (Chair
	Yamamoto)
February 23, 2017	: Hearing from Diving Worker B (Chair Yamamoto,
	Panel Member Taira)
February 24, 2017	: Meeting with Friend N of Diving Worker M (Chair Yamamoto)
February 25, 2017	: Hearing from concerned people at OIST (Chair
	Yamamoto, Panel Member Miyao)
	Employee O, Employee P, then Employee Q
March 23, 2017	: Hearing from concerned people at OIST (Chair
	Yamamoto)
	Employee R, Employee S
March 25, 2017	: Hearing from concerned people at OIST (Chair
	Yamamoto)
	Employee T
March 23-25, 2017	:
(On 23	rd and 25th, at the Toguchi port, in the presence of
Chair Y	'amamoto)
Investig	gation of the current status of the equipment

deployed on the seabed and recovery work

Examination of the recovered equipment deployed at the incident site

Besides the activities described above, information was gathered through email communications from concerned people inside and outside OIST (Chair Yamamoto)

#### 2. Summary of the diving incident

### 2.1 Purpose of the diving work

#### (1) Description of the research

The research unit led by Assistant Professor A has been carrying out extensive collection of physical, biological and chemical information (such as water temperature, salt content, pressure, dissolved oxygen, chlorophyll, turbidity, nitrate, organic matter, acidity, wave height, wave length, image, acousmato, etc.) since August 2013 for continuous, long-term monitoring of effects of climate change, global warming, acidification of the ocean, etc. on marine ecology, by deploying the Okinawa Coastal Ocean Observation System comprising various sensors and cameras at the depth of 20 m in the sea near Okinawa Churaumi Aquarium, Motobu-cho, in the northern part of the Okinawa main island.

Also, from October 2015, to cover the physical environment around the Okinawa Coastal Ocean Observation System, the unit started the expanded observation project using a tidal current direction and current meter capable of measuring directions and speed of ocean current using ultrasound. The diving work of this case was conducted as a part of this observation project.

#### (2) Purpose of the work

The intended work was to be carried out at the Ie-Suido channel near the Okinawa Ocean Observation System, which consisted of two sets of works: one was to drop a machine accommodating a tidal current direction and current meter in a buoying body called anchoring device with built-in buoy, to measure tidal current directions and speeds for a certain period (about 1 month) from the shipboard; and the other was to, at a depth of about 60 m, to bring a tidal current direction and current meter and a rack, and deploy the tidal current direction and current meter by installing it on the rack to anchor the meter by two divers. (References 1, 2 and 3)

#### 2.2 Chronology of the incident

(1) Designing the diving work

In July 2016, when Oversea Collaborator U of the OIST international advisory board for marine research visited Okinawa for the meeting of the board, he gave advice to Assistant Professor A, Diving Worker B, etc. about the plan and they designed the observation project. In the process thereof, on July 15, an image of the deployed equipment which was almost the same as the image of the deployed equipment of the incident day was illustrated on the whiteboard (Reference 4). Diving Worker B proposed that the deployment work be performed by divers. When discussing the deployment process, they focused on simplifying the procedure, such as accomplishing the work by one dive, and decided specific work procedures.

# (2) Preparation

In the afternoon of Friday, November 11, 2016, the divers carried out preparation at the OIST campus including the following works:

- Preparation of the equipment and loading on the vehicle
- Preparation of diving equipment (rebreather, backup tank, regular diving equipment), analysis of the mixed gas
- Preparation of Application of Field Work Plan and its submission
- Meeting on the work procedure of the following Monday (November 14) (see below)

07:30	: Two divers meet at the University and carry out pre-	
	setting of the rebreathers and inspections.	
08:00	: Other two work assistants join, and depart for Motobu-	
	cho.	
Around 09:00	: They arrive at Motobu-cho, bring the equipment in the	
	boat, carry out other preparatory works, and explain the	
	works to Captain.	
09:30	: They leave the port.	
	They arrive at the work area after letting a Kagoshima-	
	route ferry passing through the area.	
Around 10:00	: Start dropping buoys from the shipboard.	
Their plan was to complete all works before noon, if everything goes as		
	they had planned.	

(3) Chronology of the incident day

November 14, 2016

- The members left the University on schedule.
- They carried out double-check of the plan and members' health check in the vehicle on the way to the destination.
- On arrival at Motobu-cho, they started working a little earlier than the schedule
- Although they confirmed current flow to some extent from the movement of the surface buoy, considering that the overall environment

is good enough for the work and the tide will get milder as the time goes, they determined that they were able to conduct the planned work, Diving Worker B carrying the rack and Diving Worker M carrying the tidal current direction and current meter, and started going into water. Diver M failed to catch a rope connecting the surface buoy to the anchoring device with built-in buoy and came back to the surface. Diving Worker M did not come back to the surface during the 1st attempt of diving, and is still missing as of April 7, 2017.

[1st attempt of diving by Diving Worker B and M] With rebreather (References 5 and 6)

- Around 10:12 a.m. : Shortly after the two divers started descending underwater, when Diving Worker B looked back, Diving Worker M gave an "OK" sign and followed him.
- Around 10:15 a.m. : Diving Worker B grabbed the rope connecting the anchoring device with built-in buoy and the surface buoy, and descended along the rope. Upon arrival at the mid-depth buoy around 20-25 m from the surface, he looked back but failed to see Diving Worker M. Diving Worker B was unable to determine whether Diving Worker M could not arrive at the rope and was drifted away, or started descending when he failed to arrive at the rope, but he took a possibility that Diving Worker M was descending alone, and started descending alone.
- Around 10:17 a.m. : Upon arrival at the sea bed, he confirmed that Diving Worker M was not there.
- Around 10:19 a.m. : After connecting the rack to the plumb-bom of the anchoring device with built-in buoy with the rope, he started ascending. On the way up, he took pictures of the water temperature gauge deployed in the middle of the route with a camera, for the confirmation of the deployment conditions, while ascending.
- Around 10:27 a.m. : Diving Worker M who was considered to be drifting the surface was found by the work assistants on the shipboard and went back to the work site while holding on the ladder of the ship. Then he started descending again.

Diving Worker B joined with Diving Worker M who came down at a depth of about 10 m. Diving Worker M went first and they continued rapid descending while grabbing the rope which was connected between the mid-depth buoy and the plum-bob at the seabed (descending speed: about 27 m/min).

- Around 10:31 a.m. : At the depth of about 50 m, Diving Worker B dropped the tidal current direction and current meter which was attached to the carabiners at the waist of Diving Worker M to the sea bed.
- Around 10:32 a.m. : They arrived at the seabed, Diving Worker M first, and then Diving Worker B. Diving Worker M was standing by while kneeling, Diving Worker B arrived at the seabed on the back of Diving Worker M. Upon arrival at the seabed, Diving Worker B realized that the mixed gas was consumed, and sent an "ascending" sign to Diving Worker M from his back, and then switched to a spare air tank.
- Around 10:34 a.m. : Diving Worker B started ascending without grabbing the rope which was connected between the mid-depth buoy and the plum-bob at the seabed.
- Around 10:35 a.m. : On the way up, Diving Worker B confirmed that bubbles which were considered to be came from Diving Worker M, assuming that Diving Worker M was ascending, and continued ascending.
- Around 10:36 a.m. : When he ascended to the depth of about 20 m, he launched a balloon to let the workers on the shipboard to know the position.
- Around 10:37 a.m. : When he checked Diving Worker M at the depth of 10 m, he could not find bubbles from Diving Worker M, then he quit decompression stop, and went up to the surface. Diving Worker M didn't surface from this dive and is still

missing as of April 7.

[2nd attempt of diving by Diving Worker B] With air tank (Reference 7) Around 10:45 a.m. : Diving Worker B switched the tank to a 14L air tank, and also carrying a spare 14L air tank, started descending again along the rope.

- Around 10:46 a.m. : Although he was able to visually confirm the seabed from the depth of 44 m, he could not find Diving Worker M.
- Around 10:49 a.m. : He released the rope and went up to the surface while meandering.
- Around 10:52 a.m. : One of the work assistants on the shipboard (Ship Crew I) who was instructed by Diving Worker B reported Japan Coast Guard.
   Then, they started searching Diving Worker M on the surface from the shipboard, towards the downstream of the current.

[3rd attempt of diving by Diving Worker B] With air tank (Reference 8)

- Around 10:59 a.m. : They went back to the original point, and Diving Worker B, started descending again along the rope.
- Around 11:00 a.m. : He descended to the depth of about 51 m, and released the rope and searched for several minutes towards downstream of the current while meandering. Then, he started ascending, and continued ascending while performing decompression stop.
- Around 11:14 a.m. : After he returned to the shipboard, since he developed decompression sickness and started noticing symptoms, he inhaled oxygen.
  After that, Ship Crew I was asked to call an ambulance to send him to a hospital. He was transported from the Yamakawa port by an emergency medical helicopter to the hospital, and received re-compression therapy. (He was released from the hospital on the following day.)

# 2.3 Responses after discovering the incident

#### (1) Initial responses

Based on the references, we report the responses chronologically from the first day of the incident until the end of the searches thereafter.

- 11:06 : Ship Crew I reported the incident to the Bosai Center (OIST Help Line).
- 11:16 : Employee V of the Bosai Center contacted Employee W of the Health Center by phone.

11:20	: Employee W of the Health Center contacted Assistant
	Professor A by phone.
Around 11:30	: Assistant Professor A contacted Employee C of the
	Occupational Health and Safety Section by phone.
After 13:00	: Employee C and Assistant Professor A explained the
	situations to Vice President K and discussed how to respond
	to the situation.
After 13:00	: Employee E of the Human Resources Section contacted a
	brother of Diving Worker M by phone.
13:47	: Vice President K declared establishment of the Emergency
	Task Force based on the OIST Field Activities Manual
	(Formality was completed on November 17).
	Members of the Emergency Task Force:
	Vice President K (Director-general of the Task Force),
	Employee X (External Affairs), Employee Y (recording),
	Employee C (local arrangements), Employee Z (assistant),
	Assistant Professor A (person responsible for the fieldwork),
	Vice-president AA (Public Relations), Vise-president D
	(government), Employee E (Human Resources)
After 14:00	: Employee C and Employee AB (Occupational Health and
	Safety Section) left for the incident site.
14:00	: A patrol vessel and helicopter of Nago Coast Guard Station,
	fire department, local fishing boats, etc. searched around the
	incident sea area.
16:00	: The patrol vessel, etc. searched the sea around the incident
	area.
18:50	: The patrol vessel, fire department, etc. conducted sea
	surface search and also dive search by professional diver,
	Kudaka, of the patrol vessel was conducted. The search of
	that day was suspended at the sunset.
Around 20:00	: The Task Force conducted a teleconference with then
	President Dorfan who was staying overseas. Members: Vice
	President K, Vise-president D, Vice-president AC, Employee
	AD, and Employee Y.

Meetings of the Emergency Task Force were held at 17:00 p.m. regularly, almost every day from November 14, 2016 to January 23, 2017, at the office of

Dean for Research. In the meetings, members were reported the progress of the search activities and discussed how to respond to the situations. At the completion of the full scale search activities, the Task Force was dissolved on February 2, 2017. In addition, even after the dissolution of the Emergency Task Force, the members of the Task Force have been called as needed, to continue sharing of the information of the diving incident and discussing how to respond to the situation.

# (2) Search activities

[Search by public body] (Descriptions below are based on official announcement, etc. of the Nago Coast Guard Station)

November 14, 2016

10:52 : OIST Employee, Ship Crew I called 118.

- 14:00 : Search by the patrol vessel, helicopter, fire department, local fishing boats, etc. in the sea around the incident area.
- 16:00 : Search by the patrol vessel, etc. in the sea around the incident area.
- 18:50 : The patrol vessel, fire department, etc. conducted sea surface search and also dive search by professional diver, Kudaka, of the patrol vessel was conducted. The search of that day was suspended at the sunset.

# November 15, 2016

18:00 : 10 vessels of the Headquarters of Ryukyu Suinan Kyusaikai (Life-savers' Association), helicopter, patrol vessel, police vessel, fire department, etc. conducted sea surface search and also dive search by professional diver, Kudaka, of the patrol vessel was conducted. The search of that day was suspended at the sunset.

November 16, 2016

18:40 : The helicopter, patrol vessel, police vessel conducted sea surface search.

At the sunset, exclusive search is discontinued, and the future search will be conducted during patrolling by patrol vessels, etc.

# [Search activities by OIST]

November 16-17, 2016 : Sea surface search by a fishing boat chartered by OIST and ROV search.

November 25, 2016: Posted posters asking for cooperation to the<br/>search of missing person.Visit to local police stations, fire station, local<br/>government office, community center, etc.

After arranging the schedule taking account of the sea conditions and availability of necessary equipment, etc., the following operations were conducted.

November 26, 2016	: Underwater search using multi-beam
	(outsourcing)
	Underwater search using underwater camera
	(outsourcing)
November 30, 2016	: Underwater search using Video Ray
	(outsourcing)
December 1, 2016	: Underwater search using Video Ray
	(outsourcing)
December 9, 2016	: Search investigation using side-scan
	(outsourcing)
December 20, 2016	: Underwater search using Video Ray
	(outsourcing)
March 23-25, 2017	: Recovery of the equipment deployed at the
	seabed requested by the Panel. (outsourcing)

#### 2.4 Responding to divers' families

November 14, 2016

Human Resources Section contacted families of the two divers to inform of the occurrence of the incident. Human Resources Section and the members of the Emergency Task Force provided updated information.

Parents and eldest brother of Diving Worker M arrived at Okinawa. Vice President K and Assistant Professor A met them at the airport to escort to the hotel in Onna-son, and there, they provided information known to them up to that point, including the status of search.

#### November 15-16, 2016

Assistant Professor A escorted parents and eldest brother of Diving Worker M to the incident area, and explained about the sea area of the work. After that, the family moved to the University and waited there. Form the OIST Emergency Task Force, they were kept informed of updates of the search.

In the afternoon of 15th, Vice President K, Assistant Professor A, and Employee Z visited the home of Diving Worker B and checked his health status. They conformed the story of the diving on the incident day.

On the16th, Diving Worker B explained about what happened at the incident site to Diving Worker M's family.

In the evening, the family was informed of the end of the exclusive search by the Coast Guard Station. Diving Worker M's eldest brother went back to Aichi Prefecture alone.

#### November 17, 2016

Diving Worker M's parents visited their son's apartment, and went back home in Aichi Prefecture. Future information was to be notified to the eldest brother, and any inquiry to OIST was to be directed to Employee X of the Emergency Task Force. The family was to be updated with the latest search information.

#### December 16-18, 2016

Diving Worker M's parents visited to Okinawa again, and met people who joined the search activities at Nago Coast Guard Station, the Captain of the fishing boat chartered by OIST on the incident day, Motobu Fishery Association, Motobu Police Station, Motobu-cho Nakijin-son fire-fighters' association. Employee X escorted them.

Then President Dorfan, Vice President K, Assistant Professor A and Employee X met Diving Worker M's parents and brothers at the hotel where they stayed at, and delivered messages from the University and the University's Board of Governors. They also reported the status and schedule of the investigations. They received advice from the family for the method of establishment of the Panel.

#### February 17-20, 2017

Diving Worker M's parents and brothers visited to Okinawa, and fulfilled formalities required at the Nago Coast Guard Station, etc.

### 2.5 Communications

#### [To the people of OIST]

After the incident, internal communications have been made with the following frequency. Contents thereof include, the report of the occurrence of the incident, development of the search, investigation, status of inspection by authority, communications with divers' families, establishment of the Emergency Task Force, establishment of the OIST Review Panel of the Diving incident, etc. November 15, 2016 Diving accident Issued by: Vice President K November 18, 2016 Diving incident Issued by: Vice President K November 24, 2016 Update on Diving Incident Issued by: Then President Dorfan December 2, 2016 Diving Incident Update Issued by: Then President Dorfan December 20, 2016 Update Regarding the Diving Incident Issued by: Then President Dorfan January 25, 2017 Diving incident update Issued by: President Gruss February 22, 2017 Diving incident update Issued by: President Gruss

[To non-OIST people]

After the incident, the University released announcement on the incident with the following frequency. Contents thereof include the occurrence of the incident, development of the search, investigation, status of the inspection by authority, the establishment of the Emergency Task Force, the establishment of the OIST Review Panel of the Diving Incident, etc.

November 18, 2016	: Diving Incident
November 24, 2016	: Diving Incident Update (search activities of the missing
	divers)
December 5, 2016	: Diving Incident Update of December 5 (search activities
	of the missing divers)
December 29, 2016	: Diving Incident Update of December 29

# 2.6 Responses to Coast Guard Station and Labour Standard Inspection Office

(1) Investigation by the Coast Guard Station

By designating a liaison at OIST (Employee X), OIST set up an organizational system for cooperating to the smooth investigation, and have been cooperating to the investigation activities such as hearings of personnel concerning the incident, preparation of confession statement,

seizure of related articles, etc., all on voluntary basis. As of April 7, 2017, the investigation is on-going.

(2) Responses to the Labour Standard Inspection Office (Reference 8) November 14, 2016

The occurrence of the incident was reported immediately to the Okinawa Labor Standards Inspection Office by phone as preliminary report.

November 18, 2016

Official reporting of the incident was made by visiting to the Okinawa Labor Standards Inspection Office by visit.

December 21, 2016

Three officers from the Okinawa Labor Standards Inspection Office visited the University for inspection, and investigated the OIST system for safety management, labor management and health management, details of the incident, etc.

March 17, 2017

OIST received Recommendations for Improvements and a Letter of Instruction from the Okinawa Labour Standards Inspection Office.

The recommendations for improvements were concerning the following three violations:

- Storing records of inspection and repair of diving equipment (Industrial Safety and Health Act, Article 103 (Ordinance on Safety and Health of Work under High Pressure (hereinafter, "High Pressure Ordinance"), Article 34))
- Implementation of health examination on workers who regularly engage in diving work (Industrial Safety and Health Act, Article 66 (High Pressure Ordinance, Article 38))
- Implementation of periodical health examination on full-time employees (Industrial Safety and Health Act, Article 66 (Ordinance on Industrial Safety and Health, Article 44))

OIST was required to implement improvements and submit a report of improvement within a period of one month ending on April 17, 2017.

#### 3. Investigation and analysis of the diving work led to the incident

#### 3.1 Problems of the diving plan and preparation

The diving work which led to the incident was decided during the meeting with Oversea Collaborator U on July 15, 2016. It was to obtain tidal current data from a sensor deployed at the sea bed, besides the readings from an existing sensor which was deployed at the le-Suido channel by dropping from the surface, so that they could obtain more detailed tidal current data. At that time, they decided several parts of the design, such as deploying the sensor at the seabed by underwater operation by divers, and, before starting the full scale operation at four points in the le-Suido channel, they would conduct a test run by deploying only one point at the seabed.

All of the specific details of the diving work plan and work procedures were decided by Diving Worker B, and were explained to other members using a whiteboard, descriptions on which are recorded as a photo image. However, the investigation by the Panel revealed that processes of designing a work plan, as well as a formulated diving work plan or work procedure, etc. are not recorded as written documents, and also, the contents of the plan was not properly disseminated to all of the people who were to engage in the work. Further, not only the work directly relating to the incident, but also diving works in general which had been carried out by the Okinawa Marine Science Support Section (hereinafter, "OMSSS") can be regarded as serious problems as there is no trace of reviewing or discussing how to deal with or responding to risks, as evidenced by no preparation of decompression stop plan.

In addition, rebreathers were selected as diving equipment to be used for the work. However, the diving workers neither properly understood the operation of rebreathers which were owned by OIST, nor had developed proper skills for using them. The diving workers took trainings of rebreather up to level 2 (heliox and trimix diving), but before being qualified to take the level 2 training, i.e., there was a prerequisite of having 50-hour diving experience during level 1 (nitrox diving), the divers took the level 2 training, and even at level 2, they did not have enough diving experiences. Besides, the diving work was expected to comprise mostly vertical movements by boat entry at a sea area of rapid tidal current. Considering these, there is no choice but to conclude that the decision to use rebreathers was wrong.

Further, according to the testimony of Diving Worker B, the diving work was estimated to be completed in 30 minutes at most, from the start of the diving to the completion of surfacing, and the work was designed to carry out only one round of diving, being simplified as much as possible, taking account of their past experiences. However, they did not verify whether or not their estimate was feasible, such as by conducting pre-diving current status survey at the working area (measuring tidal current and seawater temperature) or the seabed preliminary survey by ROV (to understand visibility and the conditions of the seabed). Besides, their decompression procedure was entirely relied on diving computers. Since they were going to carry out the work in which heavy objects were carried to the seabed at the depth of 63 m to be deployed there, rebreather should not be the equipment to be used in this diving work. Besides, putting too much emphasis on the simplification of the work, they even overlooked the use of a trail line which was required by High Pressure Ordinance.

In reviewing the preparation for the diving work which they actually did, testimonies of the people related to the diving work revealed that there was no supervisor nor a backup diver on the ship, they had no spare equipment which could be used to descend up to the depth of over 60 m, or no communication means such as an underwater notebook, the length of the rope of the emergency float was only 30 m, they did not prepare any measures at all in case of a trouble happened near the seabed. In addition, the divers descended at a speed of about 15 m/min, but it is a taboo to make sudden change of the diving depth with the rebreather diving. There was a risk of a health hazard due to an increase in the oxygen partial pressure caused by the rapid descending movements. These findings can be the evidence to determine that they did not conduct any risk assessments of the diving work at all.

#### 3.2 Problems during the diving work

### 3.2.1 Negligence of the buddy system

Article 36 of the High Pressure Ordinance requires to appoint a person to communicate with the diving worker when diving work to be carried out by receiving air supplied from a cylinder. This provision exempts a cylinder carried by an individual diving worker, thus, it does not apply to the diving in this case. However, the "Divers' Textbook" which is a textbook for the qualification test of diving worker (Japan Industrial Safety & Health Association, 2016, p111, Reference 9) describes that an "observer" who monitors the diver's work is required when performing a diving style using self-support type equipment (including rebreathers). Also, the "OIST Field Activities Manual" (2015, p12, Reference 10) describes that, in the section of activities in the sea (skin diving and scuba diving), "must take buddy diving" with highlight by bold letters.

Taking into consideration the information described above, since the

rebreathers used in this case was of a diving style using closed-circulation selfsupport type equipment (closed circuit rebreather), a "observer" was required on the ship, and the buddy system was essential in order for the divers help each other.

The findings from reviewing the profiles of the diving computer (Reference 5) which was carried by Diving Worker B and Diving Worker B's testimony before the Panel are as follows:

- (i) Immediately after the entry from the ship, the reading of the depth was 6 m. A possible factor of this reading can be an influence of the heavy object he was carrying (the frame of the tidal current direction and current meter to be deployed at the seabed, which was 13 kg when measured on the land), and, upon entry into water, his body descended rapidly to 6 m. Also, Diving Worker M was carrying the tidal current direction and current meter (which was 18 kg when measured on the land).
- After that, they started descending towards the anchoring device with builtin buoy which was deployed around the depth of 20 m, and, at that time, Diving Worker B confirmed Diving Worker M who was descending behind him (at the depth of 5 m) (buddy diving).
- (iii) During the descending movement, he found that he could not see Diving Worker M (solo diving).
- (iv) Due to the influence of the tidal current (Diving Worker B testified before the Panel) the anchoring device with built-in buoy was drifted to around the depth of 27 m, and when he reached there, he could not confirm Diving Worker M (solo diving).
- (v) He continued the descending movement to the seabed (63 m)
   (descending speed: about 15 m/min), but he could not confirm Diving
   Worker M (solo diving). It took him little over 5 minutes up to this point.
- (vi) After tying up the frame Diving Worker B was carrying to the plumb-bob at the seabed, he ascended to the depth of 10 m, while taking about 7 minutes (solo diving). He slowly ascended while taking pictures of equipment, etc. which were deployed at the seabed by Diving Worker B himself (ascending speed: about 7 m/min).
- (vii) When he was carrying out decompression stop at the depth of 10 m, Diving Worker M joined (buddy diving). Diving Worker M surfaced once. They descended to the seabed (63 m) to deploy the equipment carried by Diving Worker M (buddy diving, descending speed: about 27 m/min).
- (viii) After arriving at the seabed (63 m), as Diving Worker B became unable to continue breathing from the rebreather, then, he sent a sign to Diving

Worker M from behind by putting Diving Worker B's hand in front of Diving Worker M, then switched the tank to the emergency spare tank, and started ascending leaving Diving Worker M at the seabed (solo diving).

(ix) When ascending, the necessary decompression stop was aborted and ascended to the surface.

As explained above, the divers followed the buddy system immediately after the entry into the water, but started solo diving on the way to the seabed. In the Diving Worker B' s 2nd diving attempt (10 m), it seems that the buddy system was taken from the start of descending until the arrival at the seabed (63m), but the emergency ascending from the seabed was solo diving from the beginning. This practice is a clear violation of the OIST Field Activities Manual, negligence of the buddy diving procedure.

#### 3.2.2 Lack of proper procedures in case of emergencies

As pointed out above, the divers followed the buddy system for several meters after they started the 1st diving attempt, but when Diving Worker B arrived at the mid-depth buoy (27 m in depth), Diving Worker M was out of his sight. Diving Worker B should have ascended to find Diving Worker M at this point. Then, he started solo diving, arrived at the seabed, installed the equipment he was carrying, and then slowly ascended to the decompression point of 10 m where Diving Worker M joined him. At the joining, he did not check the cause of separation. Diving Worker B started diving again, prioritizing the deployment of the equipment that Diving Worker M was carrying. Their original plan did not include going to the seabed twice. After Diving Worker B who arrived at the seabed for the 2nd time confirmed the arrival of Diving Worker M from behind, he started ascending alone. He should have taken the buddy system to ascend. Since then, Diving Worker M has been missing.

OIST Field Activities Manual (p5, Reference 11) has the following provisions: "A relevant faculty member or section leader shall serve as the Lead Investigator."; "The Lead Investigator may appoint a Supervisor who assists the Lead Investigator, for the industrial safety and health management of the participant on site, prevention of accidents and appropriate conduct of Field Activities."; and "In case that the Lead Investigator does not take part in Field Activities, the lead investigator shall appoint a Supervisor from among the people who take part in the Field Activities, and cause the Supervisor to serve to ensure safety and health and compliance with relevant legal and regulatory rules.". In the subject case, the lead investigator did not take part in the field activities, but no supervisor was appointed.

If a person who is capable of formulating criteria for suspending the work and making a decision based thereon was on board, it would have been possible to decide suspension of the work at the time that Diving Worker M floating the surface was found by the work assistants on the shipboard and he returned to the work site while holding on the ladder of the ship.

Diving Worker B ascended to the surface, while ignoring the decompression stop procedure in all three series of his diving attempts on that day. In fact, immediately after the 3rd series of diving attempts, he started noticing symptoms of decompression sickness, and was transported to the hospital by the emergency medical helicopter to receive recompression therapy. These reckless acts which would have led to secondary accidents could have been avoided if there was the lead investigator or a supervisor at the site.

#### 3.2.3 Problems of the work schedule

According to the testimonies in the Panel, it is appeared that the work schedule was decided under the circumstances as described below.

The subject work was planned during the meeting held on July 15, 2016. Then, during the work on the preparation of the plan, taking into account several factors involving in the work such as the equipment procurement and delivery schedule, hydrographic conditions of the working area in November, Captain's schedule, Oversea Collaborator U's next visit to OIST, and the schedule of Diving Worker M who decided to leave OIST in December and his work schedule associated therewith, the week of November 14 was the only option for them to complete the work before Diving Worker M leaves.

Diving Worker M planned a business trip after the work on November 14. According to the notification submitted to the Nago Coast Guard Station before the work, the work was scheduled to take place from 14th to 25th (Reference 12), however, it is seemed that there was a strong demand to complete the work on the day of November 14 alone.

Considering that they did not take into account November 14 was the day of spring tide or a period of time during which the tide stops (according to the testimony, they planned to complete the deployment before noon and start preparing for the works to be performed on the following days), etc., they prioritized convenience for the work than the natural factors. In addition, the tight schedule after November 14 is likely to have strongly affected the Diving Worker B's decision to quit the buddy system and go to the seabed alone after he lost Diving Worker M during the first round of entry.

#### 3.3 Other matters investigated

The day of the incident, November 14, 2016 was a day of spring tide, called "super moon". The Panel investigated whether or not there was any influence of the "super moon" on the occurrence of the incident.

To investigate, taking into consideration the importance of the data of tidal current directions and speeds on that day, the Panel requested to recover the tidal current direction and current meter inside the anchoring device with built-in buoy which was left deployed at the seabed after the incident for the extraction and analysis of the data.

The Panel compared the data of heights and speeds of tidal current between the readings of the tidal current direction and current meter on that day (Reference 13) and the past data of other multiple days corresponding to the spring tide excluding the incident day and days of "super moon" (Reference 14), but didn't find any evidence that the "super moon" gave a remarkable influence on the heights, directions and speeds of the tidal current of that day.

However, the Panel was at least able to confirm the tidal current directions and speeds (at the depth of about 25 m to 15 m) at the time of the occurrence of the incident from the readings of the recovered equipment. It took 15 minutes for Diving Worker B from the start of emergency ascending and then started descending again along the rope to reach the depth of 40 m. Assuming that tidal current directions and speeds near the seabed were similar to the readings and Diving Worker M was drifted under neutral buoyancy for some reason, the Panel confirmed that there was the current that was fast enough to drift him away for at least 100 m in 5 minutes. This finding agrees to the testimony by Diving Worker B that he could not find Diving Worker M despite his 2nd and 3rd dive search attempts at the equipment deployment site.

Further, before the recovery of the equipment from the seabed, the Panel also investigated whether or not Diving Worker M was carrying out some works at the seabed alone, using a remotely operated vehicle (ROV; a robot with underwater TV camera). Then, it was confirmed that the tidal current direction and current meter which was carried by Diving Worker M and dropped from around the depth of 50 m towards the seabed by Diving Worker B was not secured on the frame and left disposed at the seabed a little away from the frame. From this scene, it is not likely that Diving Worker M was working alone after Diving Worker B started ascending, which is also agree to the Diving Worker B's testimony.

#### 4. Investigation and analysis on the underlying causes of the incident

This chapter describes the results of the investigation and analysis which were carried out focusing on the organizational factor including the safety and health management system of OIST which forms the background of all factors which eventually led to the diving incident, and environmental and human factors surrounding the incident.

#### 4.1 OIST management and administrative organization

#### (1) Organizational structure

It can be said that research at a university is a challenge to open up the frontier of a new field where identification of safety and risk. Besides, it undertakes education of students who have not equipped with complete skills for recognizing risks and achieving the research goal. Responsibilities for safety management and accident prevention in research are assumed primarily by the lead investigator, i.e., the faculty or unit leader, and thus, the duties of the lead investigator are to properly manage his/her research organization in the relevant research, ensuring members' health (including mental health) maintenance, develop good understanding of risks in research activities, continue efforts for the prevention of accidents in everyday activities, and increase awareness of risks in research which is shared among all members of the organization. However, since the lead investigator's primary duty as a researcher is to undertake research and education, he/she may not always have expert knowledge to fulfill the duties of organizational management or safety management. Therefore, in general, the university's supporting organization properly grasps the actual situation of the research and education, and serves to disseminate legal matters to be complied with by researchers, confirm that the activities are carried out properly, provide instructions for resolving issues, and, in addition to these, if any fatal issue has been discovered, the organization orders the researchers to stop the activity, and make responses if any accident occurs.

Further, in order to perform specific research operations of researchers, a technical team to support the operation and other people who take over other aspects of the operation such as clerical works are also required. Thus, in an actual research unit, technical staff (including vendors) and clerical staff members are engaged in these works. These works performed by the supporting members are also a part of research activities. Therefore, the lead investigator of the research unit is also demanded to properly manage and provide instructions to these people. In addition, the head of the supporting

section must provide appropriate consideration so that the staff members who are engaged in the operation in the supporting section can fulfill the prescribed works safely.

The ultimate responsibility for safety management at university is assumed by the managing top level, i.e., the President, which is no different from other organizations. The scope of the work of the President is very broad, and the President is not always familiar with knowledge of all relevant fields encompassed by the scope. Therefore, in general, the President's works are divided and delegated to the board members and Vice Presidents (hereinafter, collectively "Vice Presidents"), and the Vice Presidents usually have sections of staff members for the relevant field, respectively. At OIST, the Dean of Research has the authority to research budgets, research support, and safety and health management, and the Occupational Health and Safety Section is established for the safety and health management.

In general, an organization divides operations into several departments which are independent from each other so as to check operations each other. For example, operations are divided and delegated to a department which administers the primary operation of the organization, a department which supports the primary operation, and a department which manages risks and make responses if anything happens, so as to be able to continuously monitor the operations and make sure that none of the operations is irrational. The same can be said to universities, and, in general, Vice Presidents for research, research support and Environment, Health and Safety (EHS)/risk management fulfill their duties independently from each other.

At OIST, however, the Dean of Research is responsible for all these three different operations. In other words, the organization lacks a structure for mutual checks, and also, this organizational structure itself makes it difficult to make appropriate decisions in an emergency situation.

#### (2) Emergency responses

As described above in Chapter 2 (2.3(1)), after the occurrence of the incident, Crew I was instructed by Diving Worker B to report the incident to the University (BOSAI Center) on that day (at 11:06), but it took about 20 minutes before this report was passed onto Occupational Health and Safety Section (hereinafter "OHS"). Further, the incident report was passed to Vice President K, but it took two hours and a half or so before the Emergency Task Force was established. The BOSAI Center's duty was to immediately share the

information with OHS upon receipt of the report, but it contacted the Health Center instead, and the Health Center contacted Assistant Professor A, and he transmitted the information to OHS. It was lucky that all these processes completed about 15 minutes, but OIST should be reminded that it must fully disseminate the "contact system" for emergency reporting among people at OIST by posting it at many different workplaces, in order to ensure that people will act precisely in accordance with it if they face a situation that they need to make an initial report of the incident or relay the reported information. In addition, since the President was away from the University on the incident day, Vice President K commanded the Task Force.

After the information was passed to Vice President K, the Emergency Task Force was established relatively smoothly, which can be assessed that descriptions of the OIST Field Activities Manual were used effectively. In addition, as for the operations after the establishment of the Emergency Task Force, it can be said that roles of the members of the Task Force were defined clearly, and information collection and sharing of the collected information among the members of the Task Force were performed relatively smoothly.

As for the release of information to inside and outside the university was carried out at an appropriate frequency, and the first message from the administrative department was released in the morning of the following day of the incident, which is assessed as acceptable, but some people affected by the incident made claims that anxiety due to lack of information should be eliminated, etc. In addition, it took four days before releasing information to people outside the University.

Further, immediately after occurrence of an incident, the Emergency Task Force needs to perform many different tasks in a very short period of time, such as collection, selection and evaluation of information, reporting to relevant authorities or organizations, development of variety of measures and making decisions, etc. To fulfill these tasks precisely, it is essential to carry out periodical drills including a variety of high-risk situations, so that Task-Force members-to-be can appropriately develop and improve their skills. To this end, besides conventional drills based on a written script which designates certain acts to the participants in advance, it would be desirable if drills which do not inform the participants of their roles in advance, such as so-called blinded simulation, are introduced, so that the people can be prepared for dealing with any high-risk situations. Implementing these drills will help people to realize any deficiencies in manuals, etc. and will facilitate the development of an organization which is highly resistant to risks.

#### 4.2 Safety management

The OHS has responsibility of the matters related to the OIST campus-wide safety and health management. Also, for the health management of the OIST members, the Health Center and the University Clinic were set in place immediately under the President, and the industrial physician is appointed to the latter.

The role of OHS is to undertake the safety and health management at OIST in general, disseminate legal and regulatory provisions related to safety and health which apply to universities, confirm compliance therewith, send information on safety and health, provide safety and health education common to all people at OIST, serve as a liaison to relevant authorities, serve as a liaison to the authority when a research unit is required to submit a notification related to safety and health of education/research. However, the members of OHS are not necessarily equipped with all ranges of expert knowledge on the advanced research carried out in research units. Thus, it is suspected that there was a certain limitation in its capacity to provide an advice to ensure compliance and safety of all machines used in research at OIST, from the standpoint of general safety and health at workplace.

As for the Health Center and the Clinic, they provide health examination required by law, medical checks and consultations by physicians (including industrial physician). Information on health collected through these activities are handled as personal information at OIST, and thus, they share the information only with the person who received these services. There is no system or structure that allows this kind of information to be shared with the lead investigator of the research unit or the head of the worker's section or unit such that these people can directly grasp the health condition of the workers they supervise.

Main activities of OIST to ensure university-wide safety and health consist of the following three activities based on the Act on Industrial Safety and Health:

- (i) A committee for university-wide safety and health;
- (ii) Workplace inspection; and
- (iii) Workplace inspection by the industrial physician.

The President has the ultimate responsibility and is the sole authority for the university-wide safety and health management, and the duties are delegated to a safety and health officer who is appointed by the President (at OIST, the Dean of Research). At OIST, the Safety and Health Committee is the highest organization for the meeting of safety and health. According to the past records of the Safety and Health Committee, in particular, meeting minutes up to August 2016, the Chair and the industrial physician were absent in quite many meetings. However, this problem was resolved when Vice President K was appointed in September 2016 and the industrial physician became a full-time position. In addition, the timing of the workplace inspection by the industrial physician has also been improved and is now conducted at the same time as the workplace inspection by the Safety and Health Committee members.

The Safety and Health Committee is the foundation of the university-wide safety and health activities, thus, the meetings require attendance of all members including the Chair, the industrial physician, the Manager of OHS, etc., and the agendas and discussions in the meetings must be reported to the President, etc. The Committee's activities must be linked to the vitalization of university-wide safety and health activities and the reinforcement of safety culture of the university. In general, safety committee meetings at universities maintain attendance of at least 90% of all members, where their core members attend 100%. The same results can be observed in private companies.

The workplace inspection is implemented before the respective meetings of the Safety and Health Committee, and the industrial physician join this inspection to implement the workplace inspection by the industrial physician. However, the items being pointed out in these inspections do not go beyond confirmation of visible physical danger such as fall preventions, hallway spaces, and emergency shower functions. Improvements in the inspection items are also demanded, such that the members will be able to point out possible health and hygiene issues and dangerous works in specific research activities.

Further, at present, it is difficult for OHS to suspend activities described in a research plan submitted by a research unit, unless there is an obvious danger or violation of law. However, the form of the research plan does not cover all of the necessary items. Thus, in the present case, OHS should have supplemented necessary information to make sure that actual activities of the research unit of Assistant Professor A and OMSSS complied with provisions of relevant Acts and OIST Rules, such as by conducting a walkthrough inspection and/or hearing from the members, and, if there was any insufficiency, provide necessary guidance accordingly. At OIST, research activities have been carried out in places outside the main campus, e.g.,

open-sea research, thus, workplace inspection needs to cover these research bases.

Diving Worker M who has been missing since the subject incident did not undertook (two) medical examinations during the period of one year before the incident. However, people who perform diving work need to receive health examinations twice per year which are required by law, so that any accidents caused by bad physical conditions can be prevented and also the workers can protect themselves from the development of any chronic or sustaining damages. If the industrial physician had inspected the research base of OMSSS and had grasped at least only a part of the reality of the research supporting activities, at least the problem of neglected health examinations should have been prevented.

OHS has been gathering information of near-accident experiences, but reported cases are less than ten per year. It seems that OIST has not developed a reporting culture. Besides, it is not easy to conduct a proper analysis to identify tendency of accidents, etc. based on such a small number of cases. Those near-accident cases should have been experienced more frequently in sections where members are engaged in fieldworks such as OMSSS, relative to the sections which conduct works on campus. However, absolutely no event was reported by OMSSS up to now. This is a problem of OMSSS which does not report, but OHS should also make efforts to create a culture that promotes reporting of information of negative events at a glance, such as information of accidents and near-accidents, so that such information can be reported as soon as possible.

In addition, as for the health management of diving workers, OIST also lacked a mechanism to promote cooperation with the Health Center in order to properly respond to workers who neglect special health examination, in view of the uniqueness of the work.

#### 4.3 Human factors

At the time of the incident, several emails reporting information were sent to the President and the Board of OIST, and information provided by these emails were submitted as references to the Panel by President Gruss who was newly assigned to the position after the incident. These emails were reviewed by the Panel, and have been found that, besides emails which questions the diving work which led to the incident, there were those which proposed issues of personnel relationship among the staff members relevant to OMSSS and organizational management involving the executives. As for
the problems of diving work, the Panel investigated and discussed, as described in Chapter 3. Considering the difficulty of the diving work of this case, it is essential that diving workers are physically and mentally healthy. Those emails provided information which cannot be ignored, and the Panel determined that the possibility of significant influences of the circumstances described in the emails on the diving worker's physical and mental health conditions cannot be excluded. Points described in the emails which are relevant to the subject diving incident can be summarized as follows:

Emails 1 and 2 (from former OIST-affiliated person to the Board; two emails from one person)

- Question concerning the diving work
- Pointing out that the diving worker might have been a harassment victim at the workplace, questions as to mental burdens associated therewith

Email 3 (From Faculty L to then President Dorfan)

- Question concerning responses in absence of the President
- Questions concerning purpose of the diving work and compliance
- Questions concerning the method of establishing the Panel, as well as transparency and fairness of the Panel

- Questions concerning the purpose of establishing OMSSS and the present circumstances

Email 4 (OIST Employee; agrees with email3)

- Advice concerning remarks by people outside OIST that OIST does not release information very much

Email 5 (From Faculty L to President Gruss)

- Question concerning troubles of relationships among people involved in OMSSS
- Question and comments concerning measures taken by OIST to respond to troubles
- A copy of past emails as evidence of the foregoing two questions
  (Such as those concerning a car accident caused by Diving Worker M)

Email 6 (From OIST students to the Panel (multiple emails))

- Concerns about physical and mental conditions of Diving Worker M from around summer of 2016
- Concerns about the circumstances of the section of Diving Worker M
- Concerns about deteriorated Safety Standard at OIST

Reviewing these emails, the Panel decided to investigate the organizational

factors and underlying circumstances which eventually led to the incident, besides the diving incident itself, and conducted hearing from concerned people.

#### 4.3.1 Circumstances surrounding OMSSS

OMSSS was established in 2012, aiming at providing support for marine research at OIST. Its name has been changed several times, at first, MSRS (Marine Sciences Resources Section; from 2012 to March 2015), then FRS (Field Resources Section; from April 2015 to August 2016), and then OMSSS (Okinawa Marine Science Support Section; From September 2016 to the present). Works of the section include, as marine research assistance at OIST, assisting the installation/operation of Okinawa Marine Observatory System, maintenance works, assisting works of research units at OIST which are involved in marine research, etc., and diving works have been carried out frequently.

In 2012, when started as MSRS, it consisted of Former Employee AE, Employee O, and Diving Worker B as a diving specialist. Thereafter, when Former Employee AE left OIST, to avoid leader-less operation of the section, then Executive Vice-President AF instructed that Employee O and Diving Worker B act as co-leaders and since then, the section has been operated under the "co-leadership" of these two people. Subsequently, Diving Worker M and Employee N were hired as a diving worker and a clerical staff, respectively, and the section was reorganized to FRS in April 2015. Thereafter, Employee R and Employee T (double positions) were hired.

In December 2015, Diving Worker B was transferred to the research unit led by Assistant Professor A, and at the same time, Assistant Professor A was appointed also to the leader of FRS. Before Employee O was going to take leave of absence from work, Former Employee Q (double positions) was assigned to replacement of Employee O, but subsequently Former Employee Q was transferred from the primary affiliation in March 2016 and was released from the position. Around the same time, Employee R fell sick and was frequently absent from the work (under temporary leave since August 2016). Thus, from April 2016 to the day of the incident, full-time workers who were actually available for the work in OMSSS were only Diving Worker M and Employee N. However, the workloads of the members of OMSSS were increasing at that time with a wide variety of works such as preparatory works for the opening of OIST Marine Science Station (hereinafter, "Marine Facility") and the International Advisory Board Meeting, both of them were to be taken place in the same period, besides the section's regular diving works.

#### 4.3.2 Personnel transfer of people involved in OMSSS

The transfer of Diving Worker B in December 2015 and that of Assistant Professor A were derived from a minor traffic accident caused by Diving Worker M in November 2015. According to the hearing from people involved in OMSSS, the accident occurred in mid-November when Diving Worker M was escorting a researcher from the diving site, and the car he was driving accidentally contacted an oncoming car on a narrow country road. Since it was a minor contact, the driver of the oncoming car left the scene very quickly, thus, there was no time for him to make a call to the police. Under such circumstances, he was unable to follow the OIST's official procedures to process a car accident. However, this lack of formal procedure was severely criticized by Diving Worker B, and he sent an email using very harsh expressions to Diving Worker M, which was carbon copied to other relevant people. In fact, the words in the email were too severe relative to the unintentional mistake, which were even out of line. His email could be determined to be a harassment to Diving Worker M and other relevant people. Since then, then Executive Vice-President AF concerned about words and behaviors of Diving Worker B consulted the Human Resources Management Section. The then Executive Vice-President AF, Vice-President D (for human resources at that time) and then Acting President Wagner discussed the issue and decided that, for the purpose of improving Diving Worker B's management ability, Diving Worker B was to be transferred to the research unit led by Assistant Professor A, and appoint Assistant Professor A to the section leader of FRS (dual positions).

#### 4.3.3 Assistant Professor A

Assigning Assistant Professor A to the section leader in addition to the unit leader was aiming at correcting the operation of the section, as it could hardly be considered successful up to that point. Assistant Professor A viewed that the root of the problem of the operation was the absence of dedicated leader and lack of human resources, and he requested the executives to reinforce the members including the leader. These actions taken by him can be evaluated positively, however, the recruitment process was delayed considerably. Although it is understandable that a best possible person cannot be found very easily, he did not make any further movements to speed up the processing by the Human Resources Section. His attitude could be naturally evaluated as a reflection of Assistant Professor A's lack of understanding of how serious the situation of personnel shortage was, in particular, seriousness of the absence of a proper number of divers.

According to the testimony of Assistant Professor A before the Panel, Assistant Professor A had been involved in the research and development operations associated with diving in his research unit, such as the installation of the Okinawa Marine Observatory System, for a period of about 5 years before he was appointed to the leader of OMSSS. He overestimated and was overconfident in Diving Worker B's ability as an occupational diver, from Diving Worker B's achievements at the time of the installation of the Okinawa Marine Observatory System and the comments of the collaborator whom he trusted, and he left all the decision-making concerning works associated with diving to Diving Worker B. There is no choice but to determine that his attitudes are the abandonment of checking function as the lead investigator of the project, even if it was unintentional.

Also, in the subject case, as well, Assistant Professor A omitted assessing risks of the diving plan, was not present on the diving site, and did not appoint a supervisor which was set forth in the OIST Field Activities Manual. It is suspected that, if there was a supervisor on the ship on that day, at the time that Diving Worker M was found floating on the surface by the work assistants on the ship, a best possible instructions such as suspension of the work would be given. Further, in the testimony of Assistant Professor A before the Panel, he used expressions that could be construed that he considered that OHS was responsible for checking the fieldwork plan and confirming safety of the operation. From this, it can be said that he does not understand that the primary responsibility of research activities is assumed by the unit leader.

#### 4.4 Conditions of diving workers

#### 4.4.1 Diving Worker B

Diving Worker B has been actively involved in various projects in which OIST's research at open sea was took place as and occupational diver, since he was employed in 2012. His skills in underwater operations were appreciated by OIST researchers and their collaborators, and he earned high trust from Assistant Professor A and other researchers. This can be seen as evidence that one of his greatest motivations was to meet the needs of the researchers as his clients, based on the self-confidence in his skills. However, he neither prepared a diving plan nor kept work records whatsoever. This can be seen as evidence that his goal was to make a success of each diving work, and he did not develop a perspective that experiences must be recorded and accumulated to go further. Also, the Panel had three hearing sessions with Diving Worker B, but he commented very negatively about the buddy system which has been the global standard to increase safety of diving. Since he made similar comments several times during his testimony, the negative attitude towards the buddy system is considered to be the essence of Diving Worker B as a diver. From these pieces of evidence, there is no choice but to determine that Diving Worker B has developed a fundamentally wrong idea in the understanding of diving occupation that requires almost absolute safety.

In addition, Diving Worker B's attitudes towards other people, as confirmed in his very harsh, out-of-line expressions in his email, etc., and in the testimony of a concerned person that his comments were inconsistent and made it difficult for the other relevant people to properly responding to the situation (inconsistency of his comments were also demonstrated during the testimony of Diving Worker B before the Panel, and his explanations changed little by little in the three sessions of haring) are considered to be one of the causes of difficult personnel relationship in OMSSS and the research unit.

It is suspected that the use of the rebreathers, which was inadequate in the environment that the diving work of the subject case was to be conducted, was planned on the premise that the new rebreathers introduced in advance of the project were to be used, from the testimony of Diving Worker B. The reason why the rebreathers were introduced to the dive was that the equipment could be filled with the trimix gas which was considered to make it possible to dive as deep as 60 m with the equipment that OMSSS had at the time of the meeting of July 15, 2016 in which the outline of the diving project was formed. Diving Worker B testified that the most difficult point of the subject diving case was not the work at the depth of 63 m, but to succeed in completing all works with a single diving attempt. From his testimony, not only his lack of risk awareness towards the depth, but also his way of thinking in the planning of the diving work was confirmed, that is, on the premise of using rebreathers as the diving equipment, use of spare tanks was excluded, and, in order to finish the planned work in one day with the diving equipment of small-capacity tank, two rounds of diving would not be possible, thus, all works needed to be completed at once. In addition, since Diving Worker M was going to leave OIST, Diving Worker B planed the diving schedule very tightly with extensive works which could not be adjusted at all. It is suspected that his behavior of ignoring the buddy system when he lost Diving Worker M

shortly after the entry into the sea and started solo diving towards the seabed is related to this. However, this behavior induced the second diving attempt upon seeing Diving Worker M again in the sea, which was not in the original plan, and the lack of respiratory gas associated therewith. As a result, he ignored the buddy system again to ascend alone, leaving Diving Worker M at the seabed. These series of questioned diving behaviors are simply based on the fixed idea of "the work at the depth of 63 m = the use of trimix = rebreather" which is originated in the discussion in the meeting of July. Whether the work itself would be adequate or safe, and how would the divers respond in case of a trouble were never taken into account.

#### 4.4.2 Diving Worker M

Diving Worker M was employed at OIST as an occupational diver, partly because of recommendation by Diving Worker B. From the work notes kept by Diving Worker M and testimonies of his parents and friends, he was a very sober and proper person, spoke little, and when he faced any difficulty in doing things, he was likely to consider that his skill needed to be improved. Assistant Professor A and Diving Worker B agreed on this point. Diving Worker B assessed Diving Worker M's diving skills as follows: he may not have so many experiences in the works of installing equipment in the sea, but he tried to choose less risk when he was diving, and when it comes to the knowledge of diving techniques and equipment such as rebreather, he was superior to Diving Worker B. However, he was likely to be inflexible or stop thinking, when he faced an unexpected situation.

From the records of the emails, etc., Diving Worker M was harshly criticized by Diving Worker B, but he respected Diving Worker B's diving skills. It seems that he considered that participation of Diving Worker B was indispensable to properly carry out the maintenance of the OIST's Marine Observatory System. As seen in the testimony of a friend of Diving Worker M that, although Diving Worker B used very harsh expressions to Diving Worker M, Diving Worker M still made a remarks to protect Diving Worker B, Diving Worker M highly trusted in Diving Worker B's abilities. However, it is suspected that they did not stand on the equal footing, and there was a very strong hierarchy between them. In fact, Diving Worker M never objected diving plans made by Diving Worker B, and from the testimonies of Employee N, Employee O and Former Employee Q, it is suspected that Diving Worker M prioritized to respond to requests from Diving Worker B.

When Diving Worker M visited his parents in July 2016, he said to his

mother, "Don't be sad even if I do not return from the sea.", and "This time, the work is very difficult. I faced dangerous situations several times." Since he was practicing the use of a rebreather around that time, it is suspected that Diving Worker M had a view that the deep sea diving with a rebreather would be dangerous.

It is not very difficult to imagine that there were heavy mental burdens on Diving Worker M, facing the bad relationship among the people around Diving Worker B on the one hand, and the need of Diving Worker B for the work on the other hand. A friend of Diving Worker M also testified that Diving Worker M was bothered by human relationship rather than physical burdens, regarding his job. In addition, the reduction of the members of OMSSS (due to such as temporal leave and transfer) and the start of preparatory works to open the Marine Facility occurred around the same period, which increased workloads on him very much. These circumstances and the delayed OIST's organizational support made Diving Worker M to decide leaving OIST. The schedule of the subject diving work was decided such that the installation of the equipment and data collection as well as recovery of the equipment can be completed before Diving Worker M leaves, thus, the plan eventually became very tight with no room for adjustment. Diving Worker M missed two health examinations immediately before the incident, but it is very reasonable to consider that he was affected very much by the busy schedule due to the increased amount of works and mental burdens as pointed above.

#### 4.5 Summary of the underlying causes

At OIST, the Dean of Research is responsible for all these three different operations, including research, research support, and safety and health management. Thus, the organization has a defect in its structure for mutual checking system among the departments constituting the organization. Also, the mechanism relating to emergency calls and the system of the Emergency Task Force need to be reviewed and improved.

OMSSS was originally established as an organization for supporting research units which require marine research or marine fieldworks at OIST, and, subsequently, other important missions were added, as the expansion of the functions to support fieldworks in general, the commencement of operation of the Marine Facility, and the establishment of the Okinawa Marine Science Center. However, these developments were not well shared among the people of OIST, not even among members of OMSSS. In addition, the changes of the name of the section can be seen as evidence proving that the operation was not stable enough to respond to the development of its missions. The organizational management did not properly function, in absence of a competent leader and necessary manpower, and, in association therewith, the acting leader was appointed merely nominally without considering personnel relationship, and personnel transfer was ordered without considering relationship among duties, etc. In addition, without taking into consideration the characteristics of the works performed by diving workers, they were employed as the same status as that of the general office workers, which indicates that the executives and the administrative section did not properly evaluate diving works. This lack of understanding demonstrated by the executives and the administrative section was the primary cause of the delayed actions in the improvement of working conditions of the members of OMSSS, despite the increased workloads associated with the reduction of workable members.

Further, as it can be seen from the activities of the committee for safety and health management, it is hard to say that OIST fully complies with various Acts and instruments thereof which are provided for in order to ensure organizational safety and health. The general principal of an organizational safety and health system is that the leader of the organization must take initiative, so as to set an example for the others. But in OIST, the Chair of the safety and health committee was frequently absent from the meetings, and the Assistant Professor A commented in the testimony that "safety and health management in research is the task of OHS". These episodes strongly suggest that organizational safety culture is not developed at all at OIST, and OIST is such an organization that is driven by the pursuit of research outcome, while underestimating the importance of safety.

The diving plan of the subject case did not have a room for adjustment or a redundancy at all, and a potential trouble was not considered at all. It can be considered that it was affected by the following main factors: the ego of Diving Worker B, the person who substantially prepared the diving plan, which was bloated with trust in his own skills, the neglect of duty by Assistant Professor A who gave up checking the plan and relevant operations, and the strong hierarchy between Diving Worker B and Diving Worker M. In addition, since the subject diving work was very difficult task, the divers who carry out the work must be in excellent physical and mental conditions. Therefore, the heavy burdens imposed on Diving Worker M due to the bad personnel relationship among OMSSS members exceeded the tolerable level as a factor which led to the incident.

As explained above, as a result of the investigation of the organizational factor and conditions of the diving worker as the underlying causes, it is concluded that the circumstances surrounded Diving Worker M acted in the direction that increased risks of causing an accident.

#### 5. Summary

The Panel conducted investigation and review of the diving work and the underlying causes thereof, which led to the subject diving incident. Detailed analysis and assessment thereof are as explained in the preceding Chapters, and in this Chapter, we will summarize the whole accident and present a conclusion as the Panel.

#### 5.1 The diving work

Problems in the diving work in the subject research activities are summarized from the standpoint of work diving.

#### 5.1.1 At the time of planning the work

- (1) Lack of a risk assessment with respect to the project as a whole
- (2) Lack of a diving plan
  - Absence of measures for securing safety such as a trail line;
  - Lack of a proper decompression stop procedure based on the decompression table;
  - Absence of documentation of records; and
  - Lack of sharing information on the working procedures using written documents among people relevant to the work.
- (3) Errors in the estimation of the difficulty level of the work
  - Errors in selecting adequate equipment (in the high-speed tidal current, a large movement in the depth direction, use of rebreather in the work while carrying a heavy object)
  - Lack of estimate taking account of respiratory gas consumption when carrying a heavy object
- (4) Lacked awareness of safety measures
  - Absence of a back-up system (such as stand-by divers and spare respiratory gas source)
  - Absence of communication means between the people on the ship and the divers in the sea (the short rope length of the signal float)
  - (5) False sense of confidence developed in the diving worker, and sloppy designing of the plan
    - Selecting equipment, without mastering the proper use of it
    - Baseless decisions of working time and date, and the time of day
    - Lack of established routine procedures for safety check before work
    - Lack of criterial for deciding suspension of the diving work, and

absence of a supervisor

#### 5.1.2 At the time of the diving work

- (1) Collapse of the buddy system
  - Twice in total, including at the time of the entry, and at the time of Diving Worker B' emergency ascending
- (2) Lack of prescribed procedures in case of troubles
- (3) Behaviors ignoring rules
  - Unscheduled 2nd attempt of descending (Diving Worker B)
  - Increased oxygen partial pressure due to rapid descending
  - Neglect of decompression stop during the search dive (Diving Worker B; risk of secondary damage)

#### 5.1.3 Conclusion regarding the diving work

As described above, from the standpoint of implementation of authentic work diving, the actions of Diving Worker B and Diving Worker M were performed under a sloppy plan which was designed with no consideration of securing safety in the diving work. Also, the actions of Diving Worker B when he was in the water (neglect of the buddy system, and re-descending upon seeing Diving Worker M without surfacing) led to the loss of the final opportunity to prevent the incident.

From the planning of the subject diving work to the execution of the plan, a possibility of occurrence of a trouble during the work are not considered at all, and the plan was designed assuming that all of the procedures would be proceeded exactly as planned. In other words, there was no risk assessment of the plan. This is largely because of the ignorance and misunderstanding of Assistant Professor A who was the administrator and the leader of the research project as a whole, as well as Diving Worker B who actually designed the diving plan and was entrusted with the work as a whole, and Assistant Professor A's unconditional trust in Diving Worker B, and, in addition to these, his lacked sense of responsibility for the safety management of research.

A research unit sometimes conduct research in pursuit of research outcome even if it requires a certain degree of unreasonableness, and thus, it is easy to imagine that a difficult demand may be made to a research supporting department. Assistant Professor A as the leader of the research unit does not have an experience of work diving, but even so, he could have sought for advice of third party experts to grasp the reality and risks of underwater operations, and his lack of awareness on this point was the foundation that they had let the incident happen.

#### 5.2 Organizational structure

The Dean of Research administers the research support division, and both OMSSS and OHS are subdivisions thereof. The delay in responding to the problem of OMSSS in terms of its organizational structure while fully recognizing it, and the delay in providing measures for the increasingly expanding scope of research which is supported by OHS are both in the scope of administrative responsibility of the Dean of Research. In addition, the Dean of Research did not properly recognize risks involving in the diving works, and overlooked the reality of OMSSS that the diving works were substantially relied on decisions of Diving Worker B alone, which eventually brought into the incident. Therefore, administrative responsibility of the Dean of Research is also questioned.

However, in the first place, the organization structure of OIST concentrates the three elements of the organizational operations, i.e., research, research support, and safety and health management, risk management on research, on the Dean of Research alone. This structure does not allow mutual checking functions to work properly. This deficiency in the organizational structure has been neglected at OIST, and it can be said that the executives of OIST are also partly responsible for the neglect.

#### 5.3 Responses after the occurrence of the incident

On the day of the incident, it took about 2.5 hours before the first report of the incident reached the Dean of Research, which is also noted as a problem. The executives are required to guide the people to send the contents of the emergency call to the executives on top priority, while developing a back-up system in case of failed delivery of the information, and procedures, etc. related thereto. In the establishment of the Emergency Task Force, since functions to be required upon occurrence of an incident were not fully considered beforehand, non-OHS employees who did not receive sufficient training on risk management were suddenly included in the core members of the Emergency Task Force. These employees were forced to perform unfamiliar tasks of the Emergency Task Force without sure knowledge for a long period of time, while enduring excessive tension and stressful environment, in addition to their ordinary works. OIST's administration is responsible for this situation, and must consider properly in the process of reorganizing the structure of OIST.

Further, it is also essential that members of the Task Force must be appointed

in advance so that they can be trained through practical simulations to improve their skills. This way, they will be ready for fulfilling the tasks under emergency. The same can be said to the people who will be in charge of releasing information inside and outside the University.

It took four days before releasing information to people outside the University. It did not became a serious problem, but, with the development of advanced technology for sending information at present, there is a risk of proliferation of unconfirmed information via SNS, under a high-risk situation such as this case. However, once it happens, capacity of the Emergency Task Force will be affected very much as it will also have to deal with such situation. When a highrisk situation has occurred, members of the organization feel serious anxiety. What and how information should be released to the people in order to reduce their anxiety must be reviewed thoroughly.

#### 5.4 Safety management

The formulation and issuance of the Field Activities Manual as a risk management of fieldworks, which increased as the expansion of the research area at OIST, should be evaluated positively. In addition, it is understandable that there was a considerable difficulty in managing all activities took place on campus with a limited number of people. However, they had to gather information what research activities were carried out at OIST, and based thereon, revisions of relevant Acts and their instruments must be scrutinized to properly update manuals at a regular interval, and disseminate the information to all people at OIST.

From the references such as attendance records of the meetings of Safety and Health Committee, we have confirmed that safety and health management was quite underestimated by the people at OIST. The Chair was absent in most of the meetings prior to September 2016, which means that problems of the safety and health aspects were not properly reported to the executives of the University. At OIST, there was such a culture that safety and health were secondary to research. It is not too much to say that this University-wide culture disrespecting safety strongly affected the background of the incident.

From the establishment of OIST, the reason of its existence has always been to challenge and lead the frontier of the advanced research with the highest level of researchers who were selected from all over the world. However, these researchers are the people of first class in terms of research, but they are not necessarily a specialist in the management of a university while observing all relevant laws in Japan. Since OIST is a relatively new organization, it still lacks people who are skilled at managing the university in full compliance with laws of Japan. In the scope of university management, it may be required welcome experts in the management of a university to develop a structure that properly manages the organization and promotes the safety culture. To this end, OIST should promote personnel exchange or communication with other universities in Japan to actively incorporate and share safety and health information that they have.

#### 5.5 Regarding background factors

Next, problems which fostered the situations as described in 5.1 to 5.4 above are summarized.

#### 5.5.1 OIST managing level

The development of marine science research system, taking advantage of the geographical location of the Onna-son village in Okinawa, such as the establishment of the Okinawa Marine Science Center and the construction and the start of the operation of the Marine Facility which is expected to provide the core functions in this system, is a very attractive project because of its potential to lead OIST to become the global-scale marine science research center. However, it seems that the executives of OIST did not carry out the development of practical systems that can make this bright picture a reality and the allocation of budget to secure necessary personnel in a planned manner.

If properly designed and operated, OMSSS should have been provided with a very strong driving force, as it should be a core organization of OIST towards realization of this project. However, arrangement of personnel and management of the section have been very unstable up to now. Disharmony among the members of OMSSS, which was the cause of the personnel transfer of Diving Worker B, can be considered to be affected to some extent by the absence of the section leader and those mere temporary measures to deal with the situation.

At OIST, a very wide variety of researches of many different areas have been carried out, and, in general, research is always associated with various dangerous and harmful works. Universities are responsible for providing measures for dealing with risks for those dangerous and harmful works, while giving proper considerations to safety of researchers and students who are engaged in those works. With respect to the diving incident, the management level of OIST did not have adequate information on burdens of the diving work on the workers and impacts on their health, risks of accidents, etc. A diving worker's health conditions at the time of engaging in the work immediately affect the safety of the diving work. Thus, all diving workers must receive mandatory special health examination. But at OIST, from the view point of research management, it does not have a system to collect information of people who are required to receive special health examination. As a result, OIST did not recognize that Diving Worker M did not receive special health examinations. In addition, the victim, Diving Worker M, was going to leave OIST at the end of December 2016, but OIST did not give adequate consideration to the fact that a leaving worker was going to perform the high-risk diving work in the last few months before the termination of OIST as a whole did not properly develop awareness of risks of diving works.

#### 5.5.2 With respect to personnel transfer

OIST responded to this case from the standpoint of personnel management, and decided that Diving Worker B required adequate management training, but did not determine that there was harassment. We respect this decision, but the way OIST actually handled the case poses question. In general, when there is a suspicion of harassment in an organization, the organization prioritizes protection of the whistleblower or the victim, thus the measures they take are usually for the purpose of keeping away the alleged harasser from the whistleblower or the victim. However, in this case, the work relationship between Diving Worker B and OMSSS of the victim's section was maintained via the diving work. As a result, the personnel transfer did not change the situation so much. Rather, appointing Assistant Professor A also to the leader of OMSSS which supports the research of the unit led by Assistant Professor A has made the situation more complicated, while making it more difficult to solve the original problem. In addition, we didn't find trace of wide range of follow-up to the operational status of OMSSS and the research unit from the view point of HR after the personnel transfer. It is assumed that, regarding the organizational operation, the evaluation of anticipated effect by the personal transfers and the monitoring of the status after the transfers were insufficient.

In addition, assigning the two leader positions to Assistant Professor A, i.e., duties to manage not only the research unit but also the supporting section, is evidently imposing unreasonable burdens on a tenure-track assistant professor. To be entitled to the tenure status, he must devote all his energy to produce good research outcome. Thus, in view of his carrier stage, having him manage the operation of the section that provide support to his research is evidently creating an element that may develop into conflict of interests. In fact, Assistant Professor A was aware of this risk, and requested OIST via the Dean of Research to release him from the leader position of the supporting section, but the situation did not change at all for more than a year.

In order to increase experience points of the organization, OIST executives should review and summarize these series of decisions and responses they had made for the personnel management from the view point of smooth operation of the organization, as lessons for the future.

### 5.5.3 With regard to leaders of both research unit and section (Assistant Professor A)

According to the testimony before the Panel, Assistant Professor A has been involved in research and development work associated with diving in the research unit led by him before he was assigned to the leader of OMSSS, such as the project of installing the Okinawa Coastal Ocean Observatory System for a period of more than five years.

He highly appreciated abilities of Diving Worker B as an occupational diver based on Diving Worker B's achievements at the time of the installation of the Okinawa Marine Observatory System and the comments of the collaborator whom he trusted, and he left all the decision-making concerning works associated with diving to Diving Worker B. There is no choice but to determine that his attitudes are the abandonment of checking function as the lead investigator of the project, although it was not intentional and mainly because of overestimating Diving Worker B.

In addition, in the testimony of Assistant Professor A before the Panel, he used expressions that could be construed that he considered that OHS was responsible for checking the fieldwork plan and confirming safety of the operation. From this, it can be said that he does not understand that the primary responsibility of research activities is assumed by the unit leader.

As a result of the transfer of Diving Worker B to the research unit, Assistant Professor A did not have a choice but to accept the sudden appointment to the leader of OMSSS besides the leader of the research unit. However, this personnel arrangement not only resulted in a potential conflict of interests in terms of research support, but also facilitated the pre-existed conflicts in the relationship among section members. It failed to solve the substantial problem in the relationship among the OMSSS members which was the cause of the transfer of Diving Worker B. The section needed to develop good relationship among the OMSSS members to facilitate communications while taking account of different views of the members based on their positions, but it is suspected that this was not done adequately.

Assistant Professor A recognized that the problems in the operation of OMSSS were partly due to the lack of personnel and becoming the leader of the section was inappropriate from the standpoint of organizational governance, and requested the OIST management level to increase the number of section members and find another leader. These can be evaluated positively, but he did not take any other measures by himself such as discontinuing the activities, thus, we would suspect that he might have not completely understood the seriousness of the situation of lacking an appropriate number of divers.

Based on these findings, we would consider that Assistant Professor A was not fully aware of his responsibilities as the leader of the research unit and OMSSS and he was the person who was responsible for carrying out the project safely. His focus was on the acquisition of data for his research, thus, we would suspect that safety assurance was neglected for the works to be conducted for obtaining data for his research.

The duty of the leader of the support section is to fully understand the contents of the research and create the environment that technical staff members can work safely. However, in the subject incident, he neglected the duties of the leader of the support section, at least with regard to the understanding the skills of the diving workers and providing necessary trainings, understanding the status and results of health examinations, adequately confirming the contents of the work and sharing the information and understanding with all people involved, and demanding to design a more relaxed schedule, making decisions to discontinue the work, and making adequate emergency responses. There was serous neglect of the duties of the leader of the support section.

However, assigning the managing positions of the research unit and the support section concurrently to is evidently imposing unreasonable burdens and responsibilities on a tenure-track assistant professor. Assistant Professor A requested improvement of this situation, but effective measures were not taken at all. It can be said that the OIST management level is responsible for the neglect of necessary improvement.

#### 5.5.4 Diving Worker B

According to the information collected through hearings by the Panel, Diving Worker B has been worked as a substantial leader of the diving support work at OIST, since he was employed in 2012. It is considered that Diving Worker B's diving skills and experiences in diving works where outstanding at OIST.

However, the testimony of Diving Worker B before the Panel has revealed that Diving Worker B has a very particular belief towards diving safety, is less prepared for risks, is overly self-confident of diving skills and abilities, etc. the problems pointed out in 5.1 above are defects related to very fundamental matters to perform work diving, and, in view of his standard practices, which is not limited to the subject diving work, of performing diving work without creating or keeping diving plans or diving work records, and his very negative comments about the buddy system, it can be determined that his personality is quite self-centered and he neither looks back his own behavior nor give adequate consideration to others. Thus, we have to determine that Diving Worker B did not receive sophisticated education or training on work diving, and lacks an in-depth understanding thereof.

Diving Worker B has experiences as a leisure diver or sports diver, or an occupational diver, and has multiple qualifications relating to diving. Nevertheless, he neglected compliance with the High Pressure Ordinance. We have to determine that Diving Worker B is unfit to be an occupational diver who is required to respect safety, more than anything else, to perform any diving works. People of the OIST management level left all decision-makings associated with diving to the hands of Diving Worker B alone, without trying to realize his unfitness to diving works or without giving adequate consideration to the meaning thereof, and even without an adequate system to make the supervisor of the section or an expert to assess or check the decisions he made. These issues must be taken as serious problems, and the OIST management is responsible for neglecting these checking systems.

Judging from Diving Worker B's behaviors in the subject incident, his basic belief is that diving workers should deal with situations by themselves, and even a buddy (Diving Worker M) should be responsible for himself. This is determined to be not only violation of OIST Field Activities Manual, but the lack of basic safety measures to conduct diving.

It is evident that the main factors which induced the subject incident are the inadequate diving plan designed by Diving Worker B, his overly self-confident

attitudes or ego towards his skills, and his false belief regarding diving safety. Diving Worker B's qualities as a diver may not be a problem in performing a private adventure in the recreational field, but are inadequate as a work diver. Letting him continued diving works is highly likely to cause another incident.

#### 5.6 Conclusion

We can't tell what happened to Diving Worker M on the sea bed. However, as discussed above, the Panel concludes that the subject diving incident was not an inevitable accident due to force majeure induced by natural threats, but was an accident that could have been avoided since it was conducted with inadequate, overly self-confident, unprepared diving plan and the project management without adequate checking functions while leaving all decisions to the hands of a single person alone in combination with the inadequate organization management.

#### 6. Panel Recommendations

We would like to recommend OIST to perform organizational reform consisting of the following five elements, so that OIST will, taking lessons from the subject diving incident, continuously contribute to the society while preventing any future incidents from occurring.

# 6.1Establishment of a safety assessment system for research theme involving high-risk activities such as fieldworks

With respect to activities which may lead to a serious incident once a trouble occurs, such as diving works, an organizational system that performs a risk assessment on activity plans submitted by research units must be established. The top priority is to put a risk assessment system in place, which carry out assessment on all diving works in view of the incident case actually occurred, but research activities subject to risk assessment include not only diving works but also all field works which cannot be readily responded if anything happens. Therefore, OIST first must perform risk assessment of all research activities which take place at OIST to determine the research activities which actually require careful investigations of risks in their activity plans.

Then, for the thus-selected research activities to be assessed, OIST is requested to formulate an assessment team which is independent from research units, and, in particular, in case of a situation where OIST does not have an adequate person who performs the assessment of technical aspect, OIST is also requested to develop a flexible system such that external experts suitable for the relevant filed can be invited.

In addition, in case that an activity is determined to be difficult to conduct at OIST as a result of a risk assessment, OIST is also requested to realize a system that facilitates researchers to order works to outside vendors.

# 6.2 Reestablishment of safety and health management system built on the foundation of each individual researcher's autonomous management

Organizational safety and health management needs to be led by the top of the organizational hierarchy with strong leadership. In the case of a university which takes a very unique organizational structure, its safety and health management can be realized only when the top-down safety and health management such as a statement from the President and the bottom-up safety and health management from research units which actually manage and carry out works involving risks or harms function properly. "Research" as activities is a challenge to unknown, and it is to carry out something that nobody has ever tried in the past. Research is never ending efforts of trials and errors, and, as a matter of course, experiences more failure than success. It can be said, therefore, actions of research inherently involve risk of accidents. Securing safety of works involving such unknown areas is very difficult, but, since the person who knows best the contents of the research in the world should be the lead investigator who carries out the research, thus, the key to successful safety and health management is that the lead investigator becomes fully recognize what responsibilities he/she has in order to ensure safety in his/her own research. In general, besides actual operation of research and experimental studies, the lead investigator is responsible for all aspects associated with research activities, such as safety of works, burdens of subjects, environmental impacts, etc., and becoming fully aware of these responsibilities makes the lead investigator be qualified to explore the unknown world.

The rules that the lead investigator takes the primary responsibility for safety and health management of each individual operation of research and experimental studies is already documented in "OIST Policies, Rules & Procedures", but, as far as the results of the investigation of the subject incident case are concerned, we did not receive an impression that said rules prevail throughout the researchers at OIST. Therefore, we recommend that the President regularly express a statement on safety and health management and fully disseminate safety and health management to all researchers at OIST again, and reinforce programs to foster the sense of responsibility among researchers.

#### 6.3 Reinforcement of OHS and organizational arrangement

Under the researchers' autonomous management as discussed in 6.2 above, the role of OHS is not to perform authorization of research plans prepared by researchers, but to support the researchers by confirming that each researcher fulfills the primary responsibilities and complies with legislation relating to their research plans, and by solving problems if any. To this end, in addition to periodical updating of rule and manuals relating to safety and health management at OIST, OHS needs to quickly respond to any changes in the contents of research at OIST. In view of the diverse range of the contents of research at OIST, human resources of OHS are not sufficient, thus additional members should be recruited, and, in case of finding any violation by a researcher, the University should explicitly give OHS authority to force improvement and, in a worst case, authority to suspend the research activities. To this end, OHS should be separated from the researchers and the research support division, and be placed under the department such as "risk management division" as discussed below.

#### 6.4 Development of organizational openness

To conduct investigation, we have created an email account dedicated to the Panel and asked wide range of people to provide comments and information relating to underlying causes of the incident. However, actual responses from OIST members to provide us such information were sent to Panel members' private email addresses, instead of the OIST official email address. We would suspect that the provider of the information was afraid of insecure anonymity, although the Panel's official email account at OIST was given proper consideration to secure anonymity.

In addition, OIST has a system to receive whistleblowing of wide range of harassment and protection of concerned people. The panel received some statements that we would suspect this system is not recognized or trusted enough by OIST members.

It is understandable that it would take a while before these systems or arrangements are trusted by the members, but we would request the OIST executives to truly recognize the reality at OIST as describe above and make efforts addressed to ensure transparency and reasonableness in the organizational management and decision-making processes, in order to earn trust in the members. To this end, OIST should establish a working group where executives and staff members discuss effective way of communication between them.

# 6.5 Development of organizational system that brings researchers' ideas reality

As a part of the investigational activities of the Panel, we conducted hearings from a wide range of people who directly or indirectly involved in the incident. From the results, we received impression that the management system in this case was strongly top-down oriented.

In general, the advantage of the "top-down" system is its capability of providing good governance to the people in the whole organization and enabling to proceed with dynamic and active business development, thus, it proposes a new potential as a graduate university pursuing the most advanced studies. However, if the top-down management goes too far, there are risks of fostering harmful aspects such as concealing negative information, and committing harassment, or even research misconduct. In addition, researchers are not always good at practical works to bring ideas into reality, thus, it may negatively affect development of an effective organization.

In fact, in the subject case, the OMSSS was created as a section to support researchers for realizing the ideals, the establishment of Okinawa Marine Science Center. However, in reality, because of the imbalance between the contents of the operation and the size of human resources, its management was hardly ideal. Further, even if it was an emergency measure, a researcher was assigned to the leader of the support section, which was evidently one of the factors that made it difficult to perform objective checking of the researcher's activities. To prevent possible adverse effect of the top-down management, OIST should design an organizational structure that enables autonomous and constructive checking and balancing through all offices or sections which constitute the organization mutually check operations each other.

To this end, we would consider that OIST should establish an organizational structure, which consists of a department administering researchers and a department administering research support which are clearly separated from each other in the management lines of OIST, and also a risk management department which checks these two department impartially and independently. The heads of these departments should be at least the Vice-President level, so that they can adjust actions each other, as needed.

Further, we also consider that OIST should establish PMT (Project Management Team) in the department of administrative office, for the purpose of making superior ideas proposed by researchers to be practical form. PMT provides a function to create a roadmap and progress management for realizing a project which has been proposed by OIST executives or researchers and has been decided to be carried out, while closely communicating and making adjustment with stakes holders of the project, to embody resources necessary for a project (such as human resources, facilities, equipment, funds).

It is 6<sup>th</sup> year from inauguration, in order for OIST to experience healthy and steady development towards future, it is essential to strengthen the foundation by developing an organizational system that enables adjustment among researchers, research support and risk management each other. To this end, it is necessary to go through the stages of extensive discussion, repeated simulations, and consensus among members. Thus, we strongly demand OIST to establish a special committee with external experts for establishing the new organizational system, and move forward to realize the new system.

#### 6.6 Panel recommendation

Based on the information obtained in the process of the investigation by the Panel, the Panel proposes agendas, so that OIST will, taking lessons from the subject diving incident, continue to advance towards the future as the worldleading educational and research institution. The Panel recommends OIST to immediately start reviewing the contents of this report and take measures accordingly.

# Appendices

# Appendix 1

# Equipment installation site



12/16/2016 して、11月センチネルV・SBE56設置概要 Briefing sheet of installing Sentinel V, SBE56(Nov.2016) して参考で実際の製品とは異なります。)	e: Photos are for reference. Not taken during the field activities. Appendix 2	Sentinel V1000 Por Por Por Por Por Por Por Por	sentinel V300	$\dot{\gamma}_{2}(t, l^{\infty} t_{3})$ weight 100kg $\nu^{-2^{\circ}2^{\circ}}$ , $\dot{t}_{6}$ $\dot{\tilde{a}}_{1}$ $\kappa^{-16}$ $\tilde{\tilde{a}}_{1}$ michored on the bottom of the sea with rope
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# Industrial Safety and Health Act Article 103

(Preservation of Documents, etc.)

Article 103 (1) The employer shall, as prescribed by the Ordinance of the Ministry of Health, Labour and Welfare, keep the documents (excluding the records under the following paragraph and paragraph (3)) prepared under the provisions of this Act or ordinances thereunder.

(2) The registered manufacturing inspection, etc., agency and other agencies shall, as prescribed by the Ordinance of the Ministry of Health, Labour and Welfare, prepare and keep records in which are entered the matters pertaining to manufacturing inspection, etc., regular inspection, individual examination, type examination, special voluntary inspection, license examination, skill training course, training mentioned in paragraph (4) of Article 75, industrial safety consultant examination, industrial health consultant examination or consultant registration as prescribed by the Ordinance of the Ministry of Health, Labour and Welfare.

(3) The consultant shall, as prescribed by the Ordinance of the Ministry of Health, Labour and Welfare, prepare and keep records in which are entered the matters concerning his/her service as prescribed by the Ordinance of the Ministry of Health, Labour and Welfare.

# Ordinance on Safety and Health of Work under High Pressure Article 34

(Inspection and Repair of Facilities, etc.)

Article 34 (1) The employer shall, when carrying out a diving work, inspect diving equipment prescribed below prior to the diving, and, if it has been found that any hazards or health impairment may occur on a diving worker, provide repair or other necessary measures, according to the diving works prescribed below, respectively:

(i)Diving work using air feeding by an air compressor or manual air pump: Diving apparatus, air pipelines, signal ropes, life line and pressure regulator.

(ii)Diving work carried out by receiving air fed by a cylinder (except cylinders carried by diving workers): Diving apparatus, air pipelines, signal ropes, life line and the pressure regulator of Article 30.

(iii)Diving work carried out by receiving air fed by a cylinder carried by diving workers: Diving apparatus and the pressure regulator of Article 30.

(2) The employer shall, when carrying out a diving work, inspect facilities prescribed below at least once in the interval prescribed below, and, if it has been found that any hazards or health impairment may occur on a diving worker, provide repair or other necessary measures, according to the diving works prescribed below, respectively: (i)Diving work using air feeding by an air compressor or manual air pump:
a.Air compressor or manual air pump: 1 week
b.The device to clean the air of Article 9: 1 month
c.The hydro barometer of Article 37: 1 month
d.The hydro watch of Article 37: 3 months
e.The flow meter of Article 9: 6 months
(ii)Diving work carried out by receiving air fed by a cylinder:
a.The hydro barometer of Article 37: 1 month
b.The hydro barometer of Article 37: 1 months
(ii)Diving work carried out by receiving air fed by a cylinder:
a.The hydro barometer of Article 37: 3 months
c.Cylinder: 6 months

(3) The employer shall, when having carried out the inspection and repaired or provided other necessary measures according to the preceding two paragraphs, record a summary thereof for each time, and keep the record for a period of three years.

# Industrial Safety and Health Act Article 66

# (Medical Examination)

Article 66 (1) The employer shall, as provided for by the Ordinance of the Ministry of Health, Labour and Welfare, have medical examinations of workers conducted by a physician. (2) The employer shall, as provided for by the Ordinance of the Ministry of Health, Labour and Welfare, have medical examinations on specified items conducted by a physician on the workers engaged in harmful work operations defined by Cabinet Order. The same shall apply to the workers who have engaged in harmful work operations defined by Cabinet Order and are currently in employment.

(3) The employer shall, as provided for by the Ordinance of the Ministry of Health, Labour and Welfare, have a dentist perform medical examinations on the workers engaged in the harmful work operations defined by Cabinet Order.

(4) The Director of the Prefectural Labor Bureau may, when it is deemed necessary for maintaining the health of workers, instruct employers on basis of the opinion of the Medical Advisor in Industrial Health and as provided for by the Ordinance of the Ministry of Health, Labour and Welfare, to conduct a special medical examination and other necessary matters.

(5) Workers shall undergo the medical examination conducted by the employer under provisions of the preceding paragraphs, provided that this shall not apply in the case where a worker who does not desire to undergo the medical examination by the physician or dentist designated by the employer, submits a document to certify the findings that the said worker has and undergone a medical examination by another physician or dentist equivalent to the medical examination under these provisions to the employer.

(Submission of the result of voluntary medical examination by workers)

Article 66-2 A worker engaged in a work between 10 p.m. to 5 a.m.. (when Minister of Health, Labour and Welfare finds it necessary, 11 p.m. to 6 a.m. for the area or period which designated by Minister; hereinafter referred to as "night work") and whose night work frequency and other matters fall under the requirements provided for in the Ordinance of the Ministry of Health, Labour and Welfare taken into account the maintenance of workers' health, may submit to the employer a document certifying the results of a medical examination (excluding medical examinations in the proviso of paragraph (5) of the preceding Article), as provided for by the Ordinance of the Ministry of Health, Labour and Welfare.

(Record of Results of Medical Examinations)

Article 66-3 The employer shall, according to the Ordinance of the Ministry of Health, Labour and Welfare, record the results of medical examinations under the provisions of paragraph (1) to (4) and proviso in paragraph (5) of Article 66, and the preceding Article. (Hearing of Medical Doctor's Advice on Results of Medical Examination)

Article 66-4 The employer shall, according to the provisions of the Ordinance of the Ministry of Health, Labour and Welfare, hear the opinion of a physician or dentist on necessary measures for maintaining the health of the workers based on the results of medical examinations under the provisions of paragraph (1) through (4) of Article 66, proviso in paragraph (5) and Article 66-2 (limited to the results of the medical examinations on workers with abnormal findings).

(Measures for following-up the medical examination)

Article 66-5 (1) The employer shall, by taking into consideration of the opinion of the physician or dentist under the provisions of the preceding Article, and when it is deemed necessary, take measures including changing the location of work, changing the work content, shortening the working hours or reducing the frequency of night work, along with conducting working environment measurement, installing or improving facilities or equipment, reporting the opinion of the said physician or dentist to the Health Committee or the Safety and Health Committee, or the Committee for the Improvement of Establishing Working Hours, etc. (provided for in paragraph (1) of Article 7 of the Act on Special Measures Concerning the Improvement of Establishing Working Hours, etc. (Act No. 90 of 2002); hereinafter the same), and other appropriate measures, considering circumstances of the said worker.

(2) The Minister of Health, Labour and Welfare shall make public necessary guidelines for promoting appropriate and effective implementation of the due measures by employers pursuant to the preceding paragraph.

(3) The Minister of Health, Labour and Welfare may, when it is deemed necessary, at the

publication of the guidelines prescribed in the preceding paragraph, carried out necessary guidance etc., to employers or their organizations concerning the said guidelines.

(Notification of results of medical examinations)

Article 66-6 The employer shall, in accordance with the provisions of the Ordinance of the Ministry of Health, Labour and Welfare, notify a worker who had a medical examination carried out under the provisions of paragraph (1) to (4) of Article 66 of the results of the said medical examination.

(Health Guidance etc.)

Article 66-7 (1) The employer shall endeavor to give health guidance by a physician or an health nurse for such workers as are specially deemed necessary to strive to maintain their health according to the results of a medical examination under the provisions of paragraph (1) of Article 66 or the said medical examination under the proviso of paragraph (5) of the same article, or a medical examination under the provisions of Article 66-2.

(2) The worker endeavor to maintain the health by making use of the notified results of the health examination under the provisions of the preceding article and the health guidance under the provisions of the preceding paragraph.

(Face-to-face guidance etc.)

Article 66-8 (1) The employer shall, as provided for in the Ordinance of the Ministry of Health, Labour and Welfare, provide a face-to-face guidance by a physician (referring to assessing the physical and mental condition of workers through medical interview or other methods and to providing necessary face-to-face guidance in response thereto. The same applies below), to a worker whose working hour or other conditions fall under one of the requirements that are specified, taking into account the workers' health maintenance by the Ordinance of the Ministry of Health, Labour and Welfare.

(2) A worker shall undergo the face-to-face guidance provided by the employer under the provision of the preceding paragraphs, provided that this shall not apply in the case where a worker who does not desire to undergo the face-to-face guidance by the physician designated by the employer, and undergo a face-to-face guidance equivalent to the face-to-face guidance under the same paragraph by another physician and submits a document to certify the findings to the employer.

(3) The employer shall, in accordance with the provision of the Ordinance of the Ministry of Health, Labour and Welfare, record the results of the face-to-face guidance under the provision of paragraph (1) and the proviso of the preceding paragraph.

(4) The employer shall, based on the results of the face-to-face guidance provided for in paragraph (1) or the proviso of the paragraph (1) or proviso paragraph (2), hear the opinions by a physician as to the necessary measures for maintaining the health of the said worker in

accordance with the provision of the Ordinance of the Ministry of Health, Labour and Welfare. (5) The employer shall, by taking into consideration of the opinion of the physician under the provision of the preceding paragraph, and when it is deemed necessary, take measures including changing the location of work, changing the work contents, shortening the working hours, reducing the frequency of night work or other measures, along with reporting the opinion of said physician to the Health Committee, Safety and Health Committee or Committee for the Improvement of Establishing Working Hours, and other appropriate measures, considering the circumstances of the said worker.

Article 66-9 The employer shall endeavor to take necessary measures as provided for by the Ordinance of the Ministry of Health, Labour and Welfare, to workers whose health requires consideration, other than the workers for whom the face-to-face guidance is provided pursuant to the provision of paragraph (1) of the preceding Article.

(Examination, etc. for assessing the degree of mental burden)

Article 66-10 The employer shall, as provided for in the Ordinance of the Ministry of Health, Labour and Welfare, have a physician, health nurse or a person provided for by the Ordinance of the Ministry of Health, Labour and Welfare (hereafter, referred as "physician, etc.") perform examinations on workers for assessing the degree of mental burden.

(2) The employer shall, as provided for in the Ordinance of the Ministry of Health, Labour and Welfare, require the physician, etc. who conducted the examination pursuant to the provision of the preceding paragraph such that a worker being examined be notified of results of the examination by the physician, etc. In this case, the physician, etc. shall not provide the results of the examination of the worker to the employer without prior consent of the worker being examined.

(3) The employer shall, when the worker who has been notified pursuant to the preceding paragraph and the degree of whose mental burden falls under the requirements that are specified, taking into account the worker's health maintenance, in the Ordinance of the Ministry of Health, Labour and Welfare reports that he/she desires to undergo a face-to-face guidance by a physician, conduct a face-to-face guidance by a physician to the worker who made the report, as provided for in the Ordinance of the Ministry of Health, Labour and Welfare. In this case, the employer shall not treat the worker unfavorably for the reason that the worker made such report.

(4) The employer shall, as provided for in the Ordinance of the Ministry of Health, Labour and Welfare, record the results of the face-to-face guidance according to the provision of the preceding paragraph.

(5) The employer shall, based on the results of the face-to-face guidance according to the provision of paragraph (3), hear an opinion of a physician as to the necessary measures for

maintaining the health of the worker, as provided for in the Ordinance of the Ministry of Health, Labour and Welfare.

(6) The employer shall, when finding it necessary in view of the opinion of the physician according to the provision of the preceding paragraph, take measures including changing the location of work, changing the work contents, shortening the working hours, reducing the frequency of night work or other measures while taking into consideration the circumstances of the worker, as well as reporting the physician's opinion to the Health Committee, the Safety and Health Committee or the Committee for the Improvement of Establishing Working Hours, and/or other appropriate measures.

(7) The Minister of Health, Labour and Welfare shall publish guidelines necessary for the measures to be taken by the employer according to the provisions of the preceding paragraph, in order for such measures of the employer to be implemented appropriately and effectively.(8) The Minister of Health, Labour and Welfare may, when having published the guidelines pursuant to the preceding paragraph and finding it necessary, provide necessary guidance, etc. on the guidelines to employers or their organizations.

(9) The State shall endeavor to carry out trainings for the physician, etc. concerning effects of the degree of mental burden on the maintenance of the workers' health, and also endeavor to take measures for the promotion of carrying out health consultation for a worker who desires to make use of results of the examination being notified according to the provisions of paragraph (2) and of making other efforts addressed to the maintenance and promotion of the worker's health.

### Ordinance on Safety and Health of Work under High Pressure Article 38

(Medical Examinations)

Article 38 (1) The employer shall carry out a medical examination by the physician for the items listed below, on a worker who regularly engages in work in compressed air chambers or diving work (hereinafter, "work under high pressure"), when said worker is employed or transferred to said work, and also periodically at an interval of six months after starting said work:

(i)Investigation into past history and previous experiences in work under high pressure;

(ii)Examination of subjective or objective symptoms such as articular pain, waist pain, pain in lower extremities, ear ringing, etc.;

(iii)Examination of motor functions of upper and lower extremities;

(iv)Examination of the eardrum and hearing acuity;

(v)Measurement of blood pressure, and examination of urinary sugar and protein levels; and

(vi)Measurement of pulmonary capacity.

(2) The employer shall, if the physician finds it necessary as a result of the medical examinations of the preceding paragraph, have the worker receive additional medical examinations of the following items by the physician:

(i)Investigation of working conditions;

(ii)Pulmonary function test;

(iii)Electrocardiographic examination; and

(iv)Investigation into articles with direct radiography.

### Ordinance on Industrial Safety and Health Article44

(Periodical Medical Examination)

Article 44 (1) The employer shall provide a regularly employed worker (excluding the worker prescribed by paragraph (1) of Article 45) with a medical examination by a physician as to the following check-items periodically once every period within a year:

(i) Investigation of anamnesis and work history.

(ii) Examination of the presence of subjective and objective symptoms.

(iii) Examination of height, weight, eyesight and hearing.

- (iv) Thoracic X-ray examination and sputum examination.
- (v) Blood pressure measurement.
- (vi) Anemia examination.
- (vii) Examination of hepatic function.
- (viii) Examination of blood lipid levels.
- (ix) Examination of blood sugar level.
- (x) Urine analysis.
- (xi) Examination by electrocardiogram.

(2) Check-items for the medical examination listed in following each item pertaining to the medical examination of the preceding paragraph shall be the items listed in the each item of the same paragraph (excluding item (iv)):

(i) The medical examination conducted, for a person who has not diagnosed as requiring continuous medical observation (meaning a person who was not diagnosed as having traces of a cured past disease which is considered to be tuberculosis from the results of the thoracic x-ray examination, and a person who was not diagnosed as being apt to be affected by tuberculosis by the physician in charge; the same shall apply in the next item) from the result of the medical examination conducted pursuant to the provision of the preceding Article or preceding paragraph in fiscal year (meaning the 12 months from April 1 through March 31;

hereinafter the same shall apply in this paragraph and Articles 44-2 and 46) in which the person reached the ages of 16, in fiscal years in which the person reaches the ages of 17 and 18 respectively by the employer who conducted the said medical examination.

(ii) The medical examination that is conducted for a person who has not diagnosed as requiring continuous medical observation from the result of the medical examination that had been conducted pursuant to the provision of the preceding Article in fiscal year in which the person reached the ages of 17, in fiscal years in which the person reaches the ages of 18, by the employer who conducted the said medical examination.

(3) Check-items listed in (iii), (iv), and (vi) to (xi) of paragraph (1) may be omitted when the physician deems them unnecessary, pursuant to the standards provided by the Minister of Health, Labour and Welfare.

(4) For a person who have received the medical examination set forth in the preceding Article, Article 45-2 or the former clause of paragraph (2) of Article 66 of the Act (including a person who have submitted the documents prescribed by the proviso of preceding Article), the medical examination set forth in paragraph (1) may be provided by omitting the check-items corresponding to those which have already been received only for a year from the date in which the said previous checkups have been received.

(5) The check-item listed in item (iii) of paragraph (1) (limited to the hearing test) may be substituted with a hearing test (excluding a hearing pertaining to sound levels of 1,000 Hz and 4,000 Hz) deemed appropriate by the physician for those under the age of 45 (excluding those who are 35 and 40) notwithstanding the provisions of the said paragraph.

(Special Provisions of Medical Examination for Those 15 Years Old and Under)

Article 44-2 (1) The employer may, notwithstanding the provisions of preceding two Articles, not provide the medical examination pursuant to these provisions (excluding the medical examination set forth in Article 43 pertaining to those who have graduated from the secondary education school accredited by School Education Act or the equivalent school) for those who are 15 years old or under in the fiscal year including the day on which the medical examination forest forth in the preceding two Articles is to be executed and have already received or are expected to receive the medical examination accredited under Articles 4 or 6 of the School Health Act.

(2) A person who is 15 years old or under in the fiscal year including the day on which the medical examination set forth in the preceding two Articles, and who do not fall under the category prescribed by the preceding paragraph, may be exempted from a whole or a part of check-items of the said medical examination, when the physician deems them unnecessary.

# Appendix 9

"Divers' Textbook" (Japan Industrial Safety & Health Association, 2016, p111)

In order to conduct work diving, in addition to "Sensui-shi" who are licensed as "Sensui-shi" work divers, an "observer" who monitors the diver's work is required when performing a diving style using self-support type equipment.

潜水士テキスト(中央労働災害防止協会、2016) p111 より抜粋

潜水業務を行うためには、潜水士免許を受けた「潜水士」のほかに、自給気式潜 水方式を用いる場合には潜水者の作業を監視する「監視員」(中略)が必要とな る。

	Appendix 10 Chapter I: Preparing for Field Activities
Chapter I: Preparing for Field Activities	OIST
4-3 Working on the Coast or on Smaller Boats	4-5 Working at Sea (Skin Diving and Scuba Diving)
<ul> <li>Mays wer a cap or hat.</li> <li>Wers row-alpopry shores such a deck sneakers, sallor's boots or rain boots. Never wear high-heels, open-los studies over a deck sneakers.</li> <li>If the sun is strong, wear sunglasses and sunscreen.</li> <li>Here sin is strong, wear sunglasses and sunscreen.</li> <li>Here sin is strong, wear sunglasses and sunscreen.</li> <li>Wear forg-sleeved shirts and long pains to axond grepting surburnt or scratched by plants, animals or ords.</li> <li>Here sin is strong, wear sunglasses and surserven.</li> <li>Here sin is strong wear sunglasses and surserven.</li> <li>Here sin is strong or the wear wear metal or pains. A more strong the plants, animals or ords.</li> <li>Here sin is better to use wear-resistant paper.</li> <li>Here sin is better to use wear-resistant paper.</li> <li>Here sin is strong on small boars must follow the instructions of the captain and must always wear strongen of pains. A more strong on the struction of the captain and must always wear strongen is plants; working on strand board. Never strongen strongen and weat the edge.</li> <li>Provi tail overboard, stry calm and wait for rescue from and wait for rescue from while employed parts on the water, help them by throwing something buoyant, or try to use and dyour own life may be put in dange.</li> <li>Hyou tail overboard, stry way for the next the captain and must always water strongen the parts of strongen strongen and wait or rescue from on the mark the rescue (you cannot sints along strongen strongen</li></ul>	<ul> <li>ending a wetsult, mask, snorted, marine boots, fins, BC jacket, dire knives, gloves, and water-resistant appear.</li> <li>en scuba diving, in addition to the above, bring a tark, a regulator, a weight belt, a compass and a met sugary.</li> <li>en scuba diving flag in the anexy bring a tark, a regulator, a weight belt, a compass and a met sugary.</li> <li>en scuba diving flag in the anexy bring a tark, a regulator, a weight belt, a compass and a met sugary.</li> <li>en scuba diving flag in the area where you will diving the area where you will diving the area where you will diving the scuba diving by the area where you will diving the yoursel to the area where you will diving the area where you will diving the area where you will diving the yoursel to the area where you will diving the yoursel to the area where you will diving the yoursel to the area where you will diving the area where you we area where you will diving the area where you will diving the area where you we area where you will diving the area where you we area where you</li></ul>

OIST Field Activities Manual

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# 4-4 Working on Large Re

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- accidents by verifying the esca Before going out to sea, verify v
- and, depending on the weather caught in machinery such as wi For observation work, wear app
  - ropes that are being used. Stay during observation work. Do no Participants involved in observa dangers on deck; in particular, zone around a turning roller.
- If there is a storm, take all the n observation equipment to the flo
- deck unless it is absolutely nec Whenever possible, avoid going •
  - If you see that someone has fall take someone with you to keep
    - throw the victim something buo If you discover a fire, shout "fire'
      - before it spreads, and inform th

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<text><section-header><section-header><list-item><list-item><list-item></list-item></list-item></list-item></section-header></section-header></text>	2. General Field Activities Plan and Insurance
<figure><text><list-item><list-item><list-item></list-item></list-item></list-item></text></figure>	2-1 Submitting a General Field Activities Plan (Rules: Article 5)
<figure><section-header><section-header><list-item><list-item><list-item><list-item></list-item></list-item></list-item></list-item></section-header></section-header></figure>	A General Field Activities Plan needs to be submitted to inform the OHS Section at
<figure><section-header><section-header><list-item><list-item><list-item></list-item></list-item></list-item></section-header></section-header></figure>	activities in order that they can confirm that the activities in the plan comply with th regulations, and to facilitate a quick response in the event of an accident.
<figure><section-header><list-item><list-item><list-item><list-item><list-item><list-item><list-item><list-item><list-item></list-item></list-item></list-item></list-item></list-item></list-item></list-item></list-item></list-item></section-header></figure>	<ul> <li>Preparing the General Field Activities Plan helps to reduce risks and prevent accid providing an opportunity to gather essential information, study conditions on site, s</li> </ul>
<text><text><list-item><list-item></list-item></list-item></text></text>	simulations. The General Evald Activities Plan must include the activity site the dates (or plane
Image: a control of the control of	contact information for the accommodation, a summary of the field activities contraction for the activities and the field activities contraction for the activities
Image of the set of	by what means), and a list of participants. Where necessary, it is also preferable to
In the set of the s	additional information, such as a detailed itinerary with maps, contact details for m services. the police, and fire department: whether vou are insured or not: contact c
In the state of	lead investigator (if he or she will remain at the University), and instructions on whe a search party (how Iong after Iostion contact) For field activities that will be clone i
Assist       Taking intervention in the second intervention in the second intervention in the second intervention in the second intervention intervention in the second intervention is the second intervention is the field activities are the intervention is the second is the field activities are the second is the	country, in compliance with regulations that may exist in that country based on the
	on Biological Diversity and the Bonn Guidelines, the Plan may need to include per PIC or MAT and details of other procedures peeded to meet legal controls in that c
<ul> <li>a supervisor the activities are num any number of the field activities are to take place within the privile activities are to must be submitted if the field activities are to take place within the privile activities the submitted at laws and regulations are complex in a supervisor to a submitted at laws and regulations are to take place within the privile activities are to take place with the law and complex in a submitted at laws and regulations are to any significant of the field activities activities are to take place with the law and complex in a submitted at laws and regulations are to any significant of the activities at a submitted at activities at a submitted at a sub</li></ul>	tator is absent many or many or outstrings, regulations or outsolling access to genetic resources and the sharin many countries, regulations controlling access to genetic resources and the sharin
<ol> <li>Supervisor (Rules: Article 9, Paragraph 4)</li> <li>In order to better protect the on-site health and safety of participants, prevent accidents and ensure that field activities are run in a way that protects the health and safety of participants, prevents accidents, and complies with all laws and regulations.</li> <li>Appointing a supervisor does not exempt the lead investigator from the responsibility to ensure that field activities are run in a way that protects the health and safety of participants, prevents accidents, and complies with all laws and regulations.</li> <li>During the field activities, the supervisor with all laws and regulations are complied with.</li> <li>If the lead investigator to ensure that participants in the field activities are run in a way that protected and that all laws and complies with all laws and regulations are complied with.</li> <li>During the field activities. This supervisor will keep in obse contact with the lead investigator to ensure that participate in the field activities or and regulations, or nature of the field activities or any significant of runosof the activities on its under activities are and regulations, or nature of the field activities or any significant of runosof the activities on its under activities are and regulations, or nature of the field activities or any actine a</li></ol>	ansing from their use are becoming structer every year. You should take hole of the the country in question to prevent any violation of laws.
<ul> <li>A General Field activities are run appropriately, the lead investigator may appoint a supervisor to assist him or her.</li> <li>A pointing a supervisor does not exempt the lead investigator from the responsibility to ensure that activities are to take place within the provise and complex with and safety is protected and that all laws and regulations.</li> <li>A General Field activities are to take place within the provise and complex with and safety is protected and that all laws and regulations are complied with.</li> <li>A General Field activities are to take place within the provise and complex with and safety is protected and that all laws and regulations are compliance with.</li> <li>A General Field activities are to take place within the provise and complex with and safety is protected and that all laws and regulations are complied with.</li> <li>A General Field activities are to take place within the provise and complex with and safety in the lead investigator to ensure that participants in the field activities are to take place within the provise and activities are to take place within the provise and regulations are complied with.</li> <li>A General Field activities are to take place within the provise and regulations are complied with.</li> <li>A General Field activities are to take place within the provise and regulations are compliance investigator with and complex with and complex with and complex in the field activities and regulations or hereward takes on a supervisor from anong the participants and have him or her work to maintain safety, health and complex with the lead investigator with and complex wi</li></ul>	(Notes)
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<ul> <li>If the lead investigator will not participate in the field activities, he or she must select a supervisor from among the participants and have him or her work to maintain safety, health and compliance throughout the duration of the activities. This supervisor will keep in close contact with the lead investigator and direct the field activities. This supervisor will keep in close contact with the lead investigator and direct the field activities. This supervisor will keep in close contact with the lead investigator and direct the field activities. This supervisor will keep in close contact with the lead investigator and direct the field activities. This supervisor will keep in close contact with the lead investigator and direct the field activities. This supervisor will keep in close contact with the lead investigator and activities on site, implementing the General Field Activities Plan and province and activities on the activities of the</li></ul>	ator to at the end of each fiscal year, on March 31. Notification is not necessarily required e commined
<ul> <li>If the lead investigator will not participate in the field activities, he or she must select a supervisor from among the participants and have him or her work to maintain safety, health and compliance throughout the duration of the activities. This supervisor will keep in close contact with the lead investigator and direct the field activities on site, implementing the General Field Activities Plan and conting any accidents or changes that arise.</li> </ul>	relevant laws and regulations, or nature of the field activities occur.
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investigator and direct the field activities on site, implementing the General Field Activities Plan and renorting any accidents or changes that arise	lead
	Plan and

OIST Field Activities Manual

名渡海上保女者支

# Appendix 12

ships.

28,11,10

名護海上保安署長

To Director of Nago Coast Guard Station

名護海上保安署 署長 殿

1.

3.

# Notification of Work

20/6年/1月/0日

作業届

(伊江水道における流向流速計による海洋調査) Marine research at le-Suido channel with ADCP

調查実施機関: 学校法人沖縄科学技術大学院大学学園 Research organization: OIST

# 調查目的 Purpose of Research

伊江水道における流況及び水温調査 Current condition and water temperature survey at le-Suido channel (調査期間1ヶ月) (Research period 1 month)

### 2. 作業実施日時 Dates

設置日時:平成28年11月14日から25日のうち、海況の良い1日。 回収日時:平成28年12月14日から25日のうち、海況の良い1日。 Installation: One day with a sea condition during Nov.14 - 25 Recovery: One day with a good sea condition during Dec.14 - 25 場所 Place of work

伊江水道内1か所(図1参照)北緯 26.71179° 東経 127.85451° One site in le-Suido channel (See chart 1) N: 26.71179°, E127.85451°

4. 方法 Method Go to the site by a Motobu fisheries association ship, drop equipment from 本部漁協所属の漁船により各地点まで行き、海底 60m に投入・設置する。流向流速計の設置

及び回収をダイバー2名、船上作業員 2~3 名で行う。設置機器は図 2 参照。 the ship to sea bottom (60m), install and recover ADCP by two divers and 2-3 on board workers See chart 2 for the equipment.

5. その他Others

船上作業員のうちいずれか1名は、旅客船・貨物船等の監視を行い、航行等の妨げにならな いよう努める。 One of the workers on the boat will monitor the passing of ferries and cargo

![](_page_100_Picture_18.jpeg)

Chart 1 Collection point 図1回収ポイント 伊江水道にて計1か所にて作業予定。 The work will be conducted at one

site in le-Suido channel.

![](_page_100_Picture_21.jpeg)

# Chart 2 Equipment to be used 図2使用機器 海底 60m にて約 100kg の重りにて固定。 To be fixed in the sea bottom 60m

with100kg weights

Received by Nago Coast

Guard Station on Nov. 10, 2016

![](_page_101_Figure_0.jpeg)

![](_page_102_Figure_0.jpeg)

![](_page_103_Figure_0.jpeg)

# Appendix 14

February 8, 2017

# Tidal flow regime in the incident sea area

Okinawa Institute of Science and Technology Graduate University

For the understanding of the environment of the incident sea area, we provide the following results of tidal flow regime observation carried out in spring 2016. Of note, the day of the incident, November 14, 2016, was a spring tide, we selected the days of spring tide during the period of observation.

# **Observation summary**

Period: 53 days from March 2, 2016 to April 24, 2016.

Sea area: le-Suido channel located between Bisezaki and lejima. In a depth of about 60 m. About 50 m south from the point where the incident occurred.

Equipment deployed: Tidal current direction and current meter (Sentinel V manufactured by Teledyne). About 3 m from the sea bed to the equipment. Method of deployment: Dropping the equipment from the shipboard.

![](_page_104_Picture_9.jpeg)

Figure 1: Views of the tidal current direction and current meter deployed in the sea. A: Four observation points in the le-Suido channel (yellow pins). The observation point of the data shown herein below and the deployment point on November 14 (labeled by the red circle). Approximate location is 26.71179° north latitude, 127.85451° east longitude. B: A reference image of the tidal current direction and current meter being deployed. It is anchored at the sea bed by anchors of 100 kg in total.

![](_page_105_Figure_0.jpeg)

Figure 2: Wind conditions and sea conditions of March 9, 2016 (spring tide). The tidal range was 10 cm greater than that of the incident day (November 14), and the wind was strong. A: Wind directions and speeds (m/s) at the Nago Special Automated Weather Station: March 9 (blue), and November 14 (red). B: Heights of tide (m) at Naha Tide-gauge Station: March 9 (blue), and November 14 (red). Current speeds (m/s) of the north-south component (C) and the east-west component (D) observed by the tidal current direction and current meter. Northward direction and eastward direction are positive. The vertical axis is water depth (m), and the horizontal axis is time (hr). Solid lines are at the time of low tide, dotted lines are at 2 hours before low tide. Portions left blank are due to data deficiency.

![](_page_106_Figure_0.jpeg)

Figure 3: Wind conditions and sea conditions of March 23, 2016 (spring tide). The tidal range was 10 cm smaller than that of the incident day (November 14), and the wind was a little strong. A: Wind directions and speeds (m/s) at the Nago Special Automated Weather Station: March 23 (blue), and November 14 (red). B: Heights of tide (m) at Naha Tide-gauge Station: March 23 (blue), and November 14 (red). Current speeds (m/s) of the north-south component (C) and the east-west component (D) observed by the tidal current direction and current meter. Northward direction and eastward direction are positive. The vertical axis is water depth (m), and the horizontal axis is time (hr). Solid lines are at the time of low tide, dotted lines are at 2 hours before low tide. Portions left blank are due to data deficiency.

![](_page_107_Figure_0.jpeg)

Figure 4: Wind conditions and sea conditions of April 7, 2016 (spring tide). The tidal range was 40 cm greater than that of the incident day (November 14), and the wind was strong. A: Wind directions and speeds (m/s) at the Nago Special Automated Weather Station: April 7 (blue), and November 14 (red). B: Heights of tide (m) at Naha Tide-gauge Station: April 7 (blue), and November 14 (red). Current speeds (m/s) of the north-south component (C) and the east-west component (D) observed by the tidal current direction and current meter. Northward direction and eastward direction are positive. The vertical axis is water depth (m), and the horizontal axis is time (hr). Solid lines are at the time of low tide, dotted lines are at 2 hours before low tide. Portions left blank are due to data deficiency.


Figure 5: Wind conditions and sea conditions of April 22, 2016 (spring tide). The tidal range was 10 cm greater than that of the incident day (November 14), and the wind was a little strong. A: Wind directions and speeds (m/s) at the Nago Special Automated Weather Station: April 22 (blue), and November 14 (red). B: Heights of tide (m) at the Naha Tide-gauge Station: April 22 (blue), and November 14 (red). Current speeds (m/s) of the north-south component (C) and the east-west component (D) observed by the tidal current direction and current meter. Northward direction and eastward direction are positive. The vertical axis is water depth (m), and the horizontal axis is time (hr). Solid lines are at the time of low tide, dotted lines are at 2 hours before low tide. Portions left blank are due to data deficiency.