(2) 帰国研修員へのアフターケア、サポートについての要望

帰国研修員へのアフターケア、研修後のサポートについての要望があれば記載ください。

鉱山に関するＪＩＣＡの印刷物、ビデオなどの提供。（Ｃ）

日本での石炭鉱山の管理の移り変わり。シャフトからの鉄のワイヤーロープの試験・維持整備など。（Ｎ）

南アメリカの各研究所にスタッフを常駐させ、帰国研修員の定例の集まりでセミナーを実施する。（Ｖ）

(3) 帰国研修員のネットワークの有無、及びその活用の可能性

あなたの国に、帰国研修員のネットワークはありますか。また、どのような活動をしていますか。

ＡＢ－ＪＩＣＡ。

集まりがサンチャゴでしかないので参加できない。（Ｖ）・（Ｎ）

(4) ＪＩＣＡへの要望等

その他、ＪＩＣＡへの要望等あれば記載ください。

将来、鉱山にかかわる環境や人々への影響に関する調査をやってもらいたい。（Ｖ）

以上

付表７　当該国訪問機関に提出した英文所見

(1)ブラジル

SUMMARY REPORT OF THE TECHNICAL FOLLOW-UP TEAM FOR THE EX-PARTICIPANTS OF THE GROUP TRAINING COURSE IN COAL MINE SAFETY BY JICA

1. GENERAL DESCRIPTION

Being dispatched by Japan International Cooperation Agency as a part of its technical follow-up programs for the returned participants of the group training courses so far operated by JICA, the team, consisting of three members mentioned below, arrived in Brazil on July 23 and then continued its follow-up activities for the periods of ten days.

At the departure from Brazil, the team intend to submit a summary report of its official duties for the purpose of reference by researchers and engineers concerned in Brazil. The team members would like to avail this opportunity to express their deep appreciation for the warm hospitality and effective cooperation extended to the team members during their stay in Brazil.

2. TEAM MEMBERS

Dr. Takehiro ISEI
Head of System Safety Division,
Safety Engineering Department,
National Institute for Resources and Environment,
Ministry of International Trade and Industry.

Mr. Kiyoshi KASHIWABA
Staff Specialist for Mine Pollution Prevention,
Coal Mine Safety Division,
Industrial Location and Environmental Protection Bureau,
Ministry of International Trade and Industry.

Mr. Yoshiharu YONEYAMA
Staff,
Training Division,
Tsukuba International Centre,
Japan International Cooperation Agency.

3. OBJECTIVE

(1) The dispatch of this follow-up team aims at reviewing, assessing and evaluating the fruit of training in Japan by obtaining informations through questionnaires and interview with the ex-participants.
(2) The second purpose of the team is to hold a seminar for introducing safety policy, technology development and new ideas in the field of Coal Mine Safety.
(3) The third purpose of the team is to know the needs for the improvement of the course.
(4) The fourth purpose of the team is to refresh friendship among ex-participants themselves as well as between ex-participants and team members.
(5) The last purpose of the team is to exchange informations in general.

4. SCHEDULE OF THE TEAM IN BRAZIL

Jul. 23 Arrival in Brasilia by VP-290.
Preliminary Meeting with JICA Brazil Office.
Courtesy Call to Embassy of Japan.
Jul. 24 Courtesy Call to Departamento Nacional de Producao Mineral (DNPM), Ministerio das Minas e Energia and Ministerio das Relacoes Exteriores.
Jul. 25 Move to Sao Paulo by VP-235.
Jul. 26 Rest (Report writing).
Jul. 27 Preliminary Meeting with JICA Sao Paulo Office.
Courtesy Call to Consulate General of Japan.
Courtesy Call to Instituto de Pesquisas Tecnologicas do Estado de Sao Paulo(IPT).
Jul. 28 Move to Criciuma by SL-769. Visit to DNPM in Criciuma.
Jul. 29 Field Survey of Companhia Metropolitana and Companhia Brasileira Carbonifera de Araranguа(CBCA)
Jul. 30 Visit to Sao Pedro Mine and Eliane Ceramic Revetment.
Return to Sao Paulo by SL-769.
Jul. 31 Interview with ex-participants at JICA Sao Paulo Office.
Technical Seminar at IPT.
Aug. 1 Departure from Sao Paulo to Santiago by RG-920.

5. COMMENTS

During 10 days follow-up survey for the Coal Mine Safety Course, the team met seven (7) ex-participants, one (1) at Brasilia and six (6) at Sao Paulo. The team also visited the Departamento Nacional de Producao Mineral (DNPM), the Ministerio das Minas e Energia and the Ministerio das Relacoes Exteriores, all at Brasilia, and Instituto de Pesquisas Tecnologicas(IPT) at Sao Paulo to discuss on the post-evaluation and future improvement of the course. Field survey had also been conducted at Criciuma in Santa Catalina where the team visited three underground coal mines and one ceramic factory having several clay mines. A seminar on "Coal mine safety situation in Japan" had been held at the IPT, Sao Paulo having 26 attendants from all over Brazil.

Main topics of the follow up survey were briefly summarized as follows;

(1) Through the discussion, all the organizations pointed out usefulness of the course and also the importance of not only safety in mines but also protection of environment during development of mines. More dispatch of participants to the course was requested from many related organizations.

(2) All of the ex-participants fairly have been putting into practice the experience of the course respectively. Among of them, one notable activity was introduced by the DNPM that they are trying to set up the practical Mine Safety Regulations by the Technical Committee in which one ex-participant is working and giving many important advices using experiences of the courses. A copy of draft was presented to the team.

(3) At the meeting with ex-participants, many precious opinion had been proposed for more improvement of the course. Main suggestions by ex-participants are as follows;

   1) Prolonging of the term of the course for enrichment of practice at field trips and the individual training.
   2) Dispatch of lecturers of the course to the country of the ex-participant so as to refine of their job.
   3) Qualification of the all responsible relatives of not only technical staff but also management staff of mining organization at the country of ex-participant.(Unity of safety scale)

4) More practice at underground mines, Coal Mine Safety Center, individual training and others. (Practice is Preferable rather observation.)

(4) Seminar on " Coal mine safety situation in Japan" had been held at the IPT as follows;

1) " Policy of Japanese Coal Mine " by K. Kashiwaba

2) " Historical trend of development of safety technology for coal mines ",

" Similarity of serious disaster at coal mines "

and

" Technical background of Japanese Coal Mine Regulations " by T. Isei

(5) Field survey at Criciuma, Santa Catalina by the team was conducted at three underground coal mines of Companhia Metropolitana, Companhia Brasileira Carbonifera de Araranguа (CBCA-Underground Coal Mine) and Sao Pedro Mine. Main problems at each underground coal mine are referred as dust at working area, control of roof rock body and improvement in ventilation.

July 31, 1992

Takehiro ISEI
Team Leader

(2)チリ

SUMMARY REPORT OF THE TECHNICAL FOLLOW-UP TEAM FOR THE EX-PARTICIPANTS OF THE GROUP TRAINING COURSE IN COAL MINE SAFETY BY JICA

1. GENERAL DESCRIPTION

Being dispatched by Japan International Cooperation Agency as a part of its technical follow-up programs for the returned participants of the group training courses so far operated by JICA, the team, consisting of three members mentioned below, arrived in Chile on August 1 and then continued its follow-up activities for the periods of eight days.

At the departure from Chile, the team intend to submit a summary report of its official duties for the purpose of reference by researchers and engineers concerned in Chile. The team members would like to avail this opportunity to express their deep appreciation for the warm hospitality and effective cooperation extended to the team members during their stay in Chile.

2. TEAM MEMBERS

Dr. Takehiro ISEI
Head of System Safety Division,
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Mr. Yoshiharu YONEYAMA
Staff,
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Tsukuba International Centre,
Japan International Cooperation Agency.

3. OBJECTIVE

(1) The dispatch of this follow-up team aims at reviewing, assessing and evaluating the fruit of training in Japan by obtaining informations through questionnaires and interview with the ex-participants.

(2) The second purpose of the team is to hold a seminar for introducing safety policy, technology development and new ideas in the field of Coal Mine Safety.

(3) The third purpose of the team is to know the needs for the improvement of the course.

(4) The fourth purpose of the team is to refresh friendship among ex-participants themselves as well as between ex-participants and team members.

(5) The last purpose of the team is to exchange informations in general.

4. SCHEDULE OF THE TEAM IN BRAZIL

Aug. 1 Arrival in Santiago by RG-920.

Aug. 2 Rest (Report writing).

Aug. 3 Preliminary Meeting with Embassy of Japan and JICA Office.
Courtesy Call to Servicio Nacional de Geologia y Mineria (SERNAGEOMIN).
Courtesy Call to Enpresa Nacional del Carbon S.A. (ENACAR).
Courtesy Call to Comision Nacional de Energia.

Aug. 4 Move to Concepcion by LA-021.
Interview with ex-participants at Lota Coal Mine.
Technical Seminar at Lota Cultural Center.

Aug. 5 Field Survey of Lota Coal Mine.
Return to Santiago by LA-022.

Aug. 6 Move to Antofagasta by LA-094.
Field Survey of Escondida Mine.

Aug. 7 Return to Santiago by LA-057.
Report to JICA Office and Embassy of Japan.

Aug. 8 Departure from Santiago by LA-148.

5. COMMENTS

During eight days follow-up survey for the Coal Mine Safety Course in Chile, the team met four (4) ex-participants in Lota. The team also visited the Servicio National de Geologia y Mineria (SERNAGEOMIN), the Enpresa Nacional del Carbon S.A.(ENACAR) and Comision Nacional de Energia. Field survey at Lota Coal Mine of ENACAR and Escondida Mine had also been conducted. A seminar on "Coal mine safety situation in Japan" had been held by the team at Lota Cultural Center having 19 attendants from the Concepcion coal field area.

Main topics of the follow-up survey are briefly summarized as follows;

(1) Through the all meeting with Chilean organizations, usefulness of the course and appreciation on participation of Chilean specialists to the course were expressed to the team. Based on the background of importance of metal mine industry in Chile, significance of "Metal" mining safety course referred by the SERNAGEOMIN.

(2) All the ex-participants had fairly put into practice the experience of the course respectively. One ex-participant from Lota coal mine pointed out pretty improvement of the analysis system for the ventilation of the mine using experience of the course.

(3) Through the meeting with ex-participants, several instructive opinions had been proposed for more improvement of the course. Main suggestion are as follows;

   1) Prolonging of the course was emphasized so as to enable more experience of the individual training and field survey.

   2) More practical training at coal mines or other field is preferable rather than simple observatory tour.

   3) Introduction of investigation report or examples of serious disasters in coal mines to the course was recommended for the purpose of safety reference at each country.

   4) Increase of individual training at NIRE by two or more (mine pollution or mine support and others) was requested so that participants enable to join to multiple course.

(4) During field survey at Lota Coal Mine of ENACAR, the team visited the Victoria working area in No.3 Coal Seam underground. The team confirmed that production operation is marginally well organized, however, some improvement was recommended in dust control around working area, basic underground frame structure and precise

prospecting of the coal seam prior to decision of the mining plan.

(5) For the purpose of safety investigation at a larger scale open pit mines, the team visited the Escondida Mine located 160km east side of Antofagasta. The team made observatory tour to mining site, one processing plant and shipping yard to see safety operation and environmental control.

August 7,1992

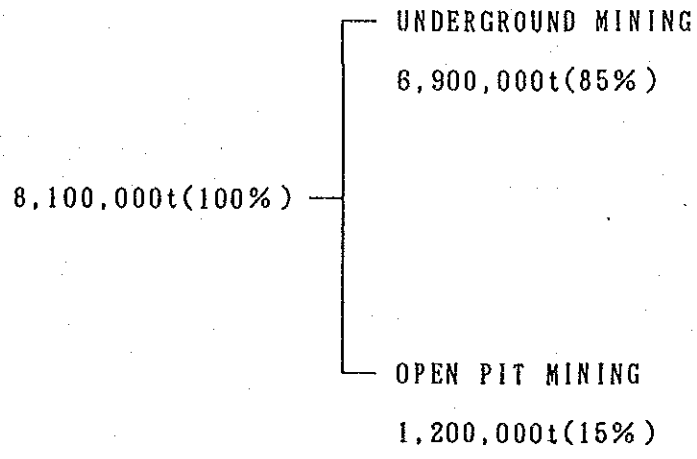
Takehiro ISEI
Team Leader

付表８　セミナー配布資料

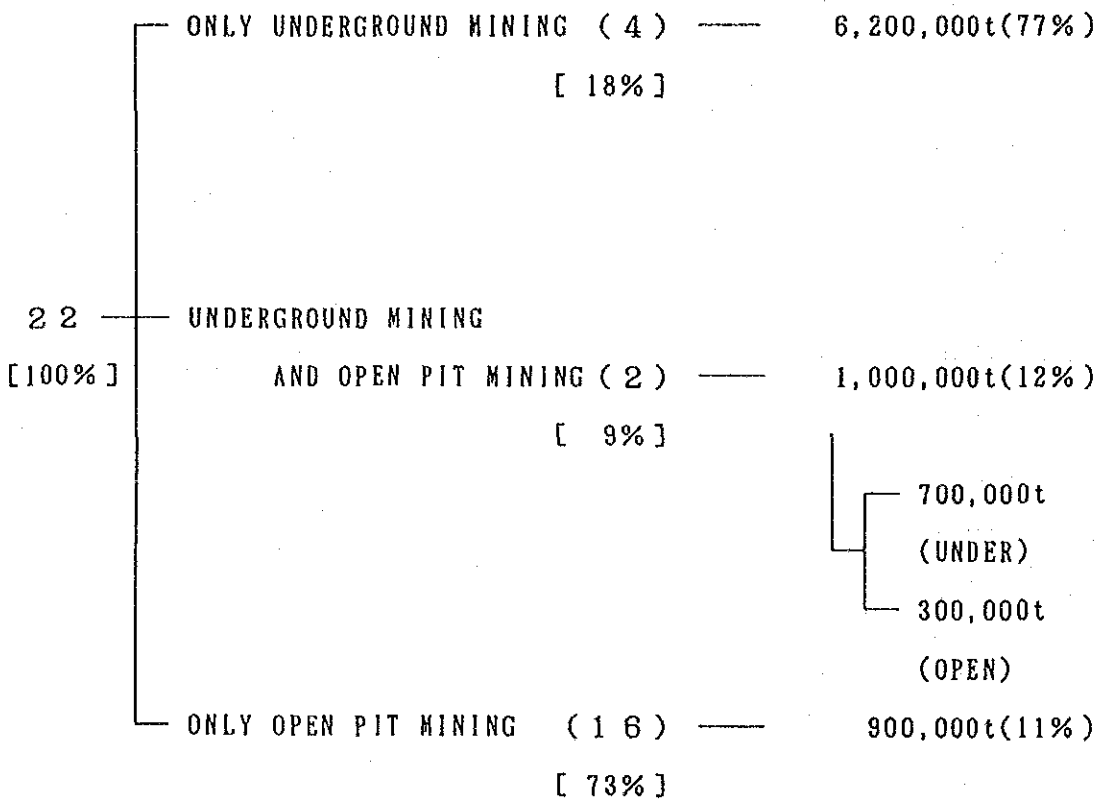
(1)柏葉団員原稿

OUTLINE OF COAL MINE INDUSTRY IN JAPPAN (1991)

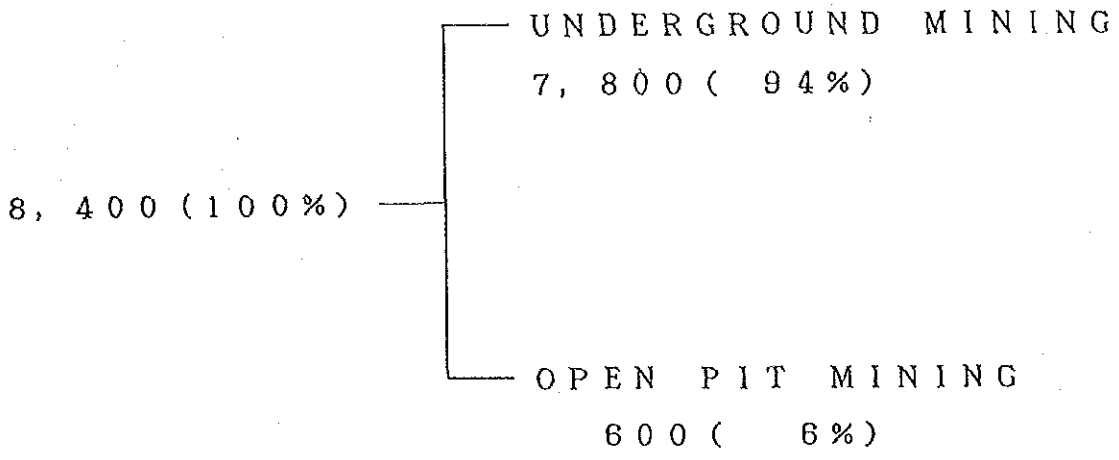
1. PRODUCTION OF COAL



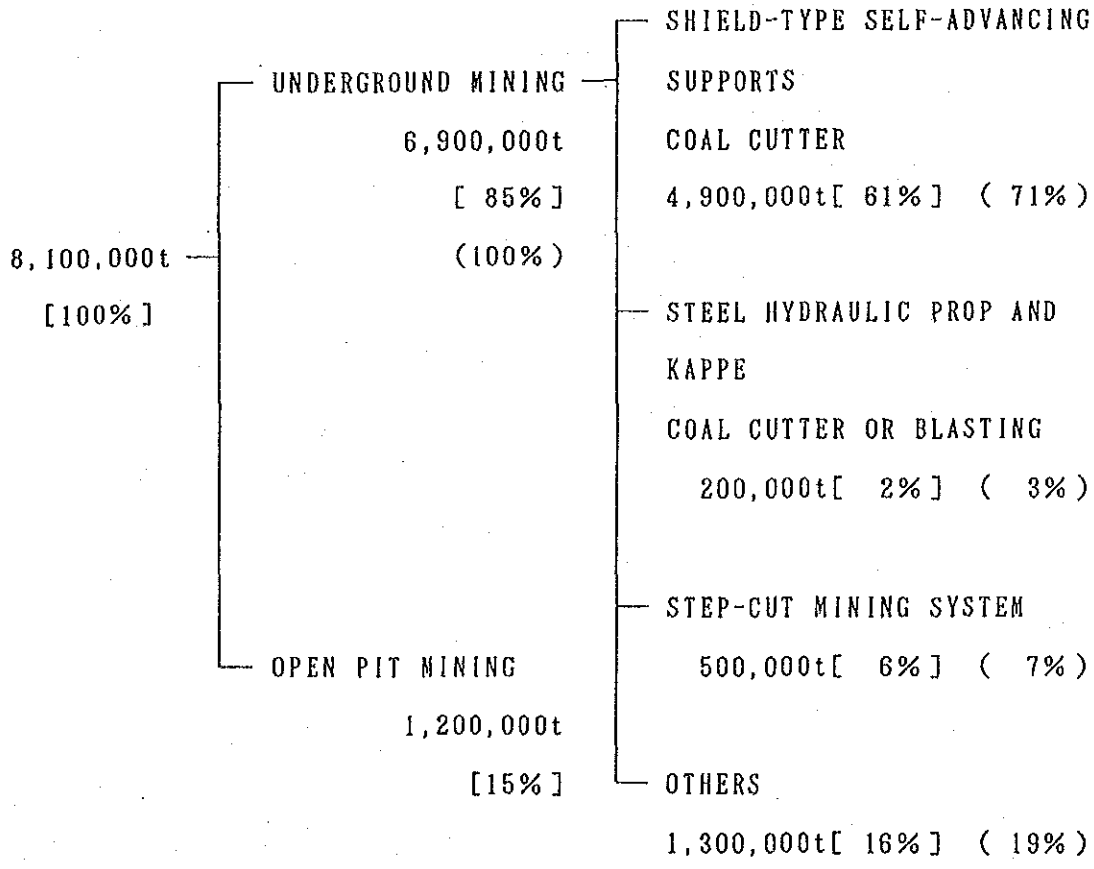
2. NUMBER OF COAL MINES

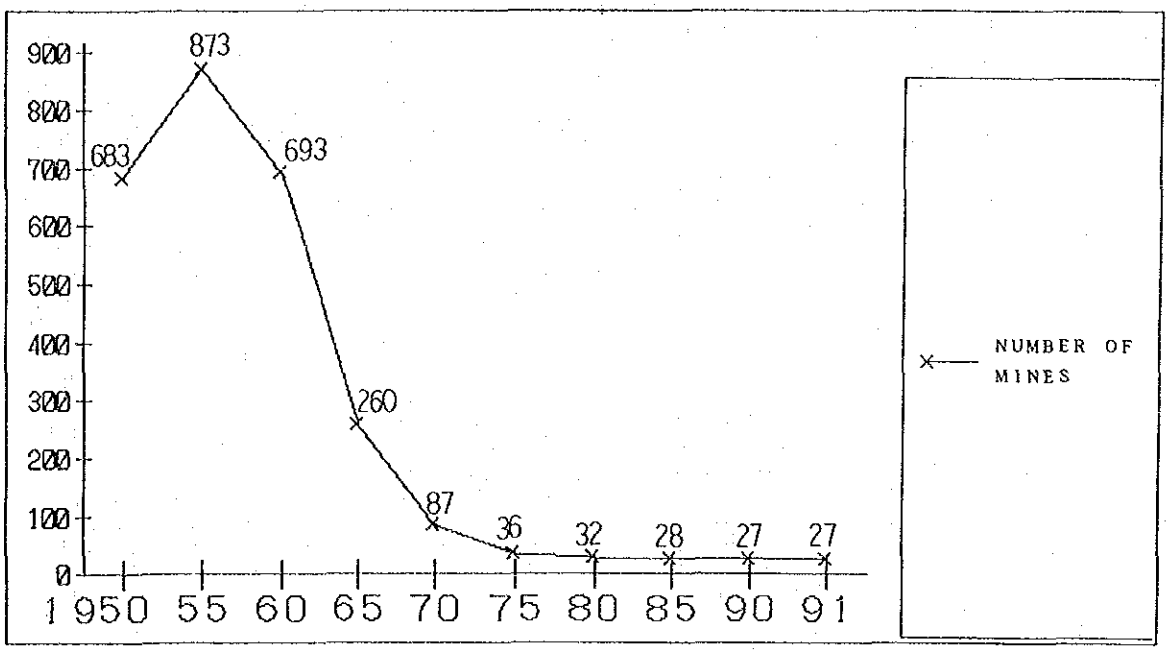


3. NUMBER OF WORKERS



4. COAL MINING METHOD




900
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500
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683
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693
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87
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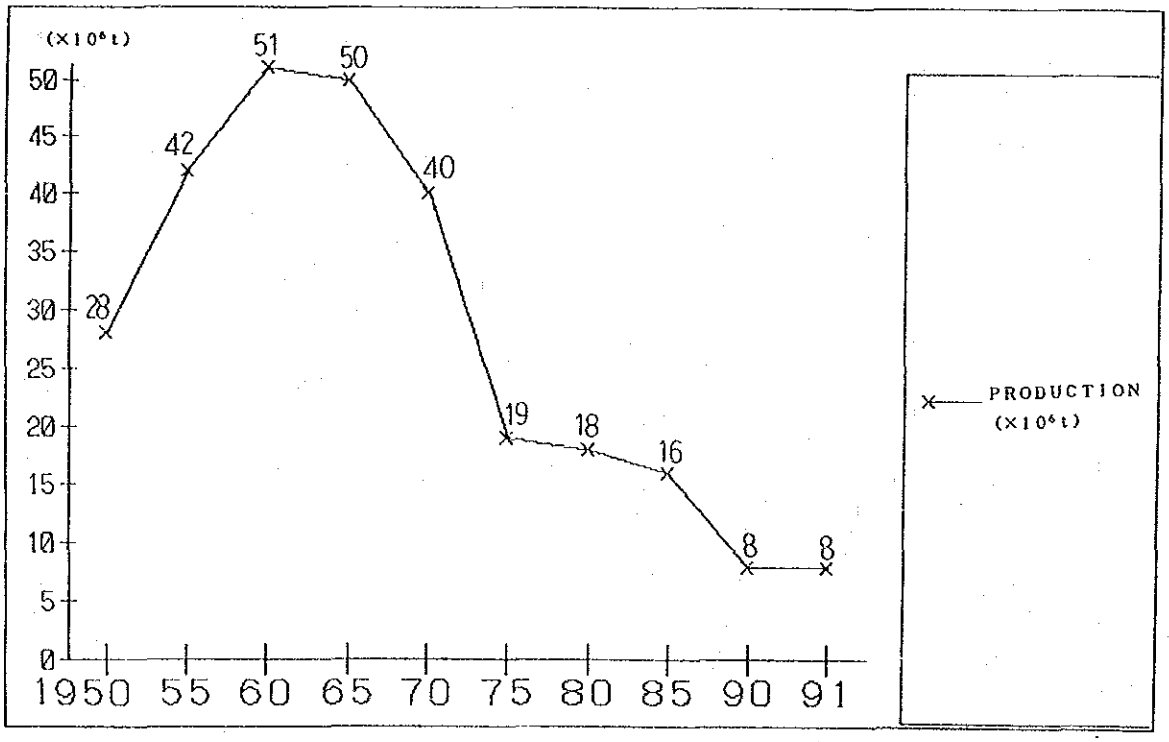
32
28
27
27
1950 55 60 65 70 75 80 85 90 91
NUMBER OF MINES


(×10⁶t)
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45
40
35
30
25
20
15
10
5
0
28
42
51
50
40
19
18
16
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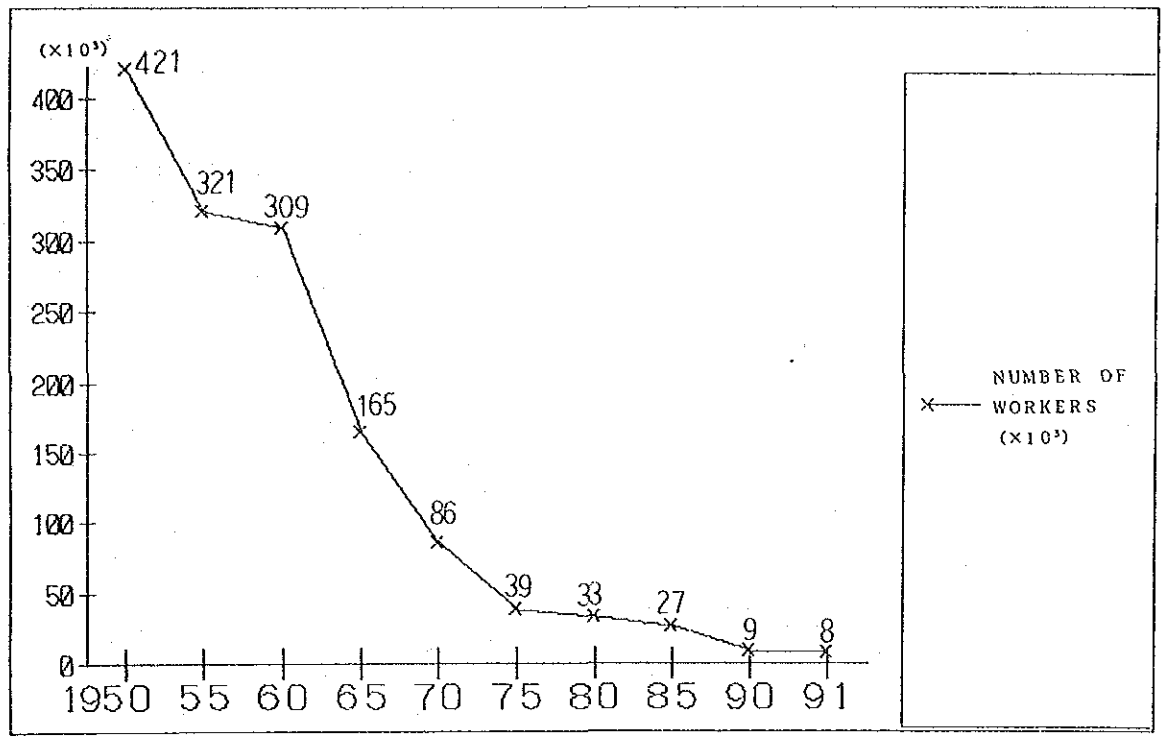
1950 55 60 65 70 75 80 85 90 91
PRODUCTION (×10⁶t)


(×10³)
421
321
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165
86
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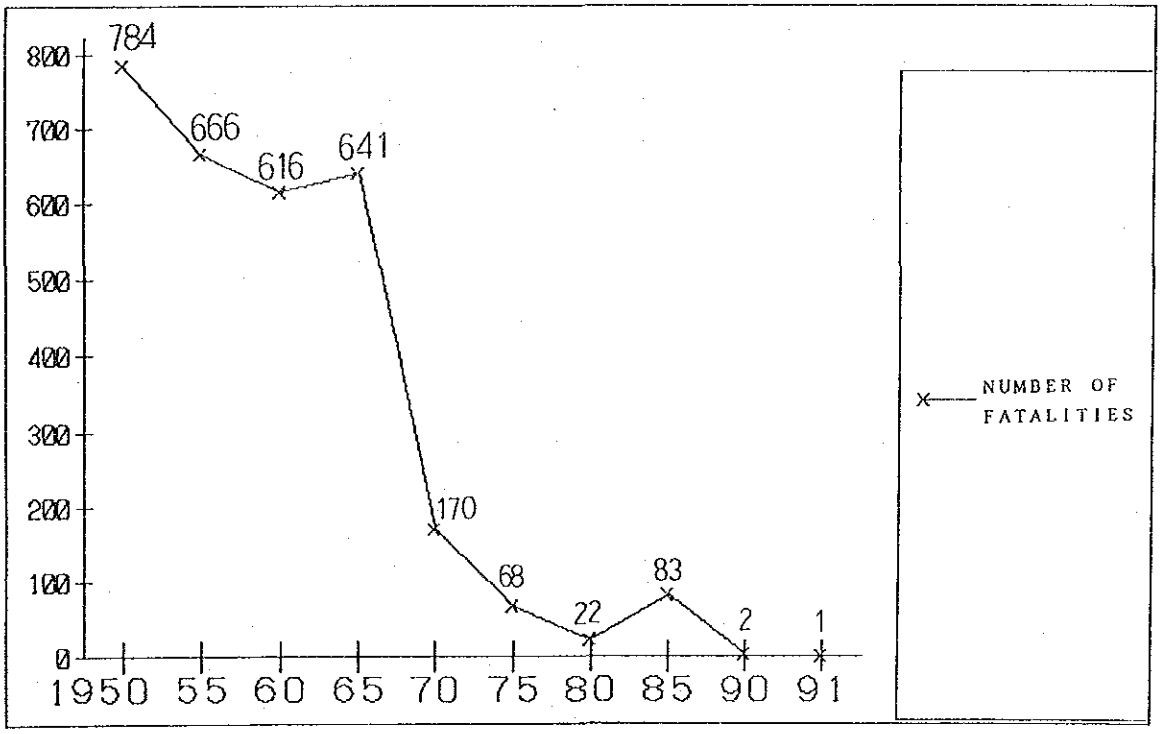
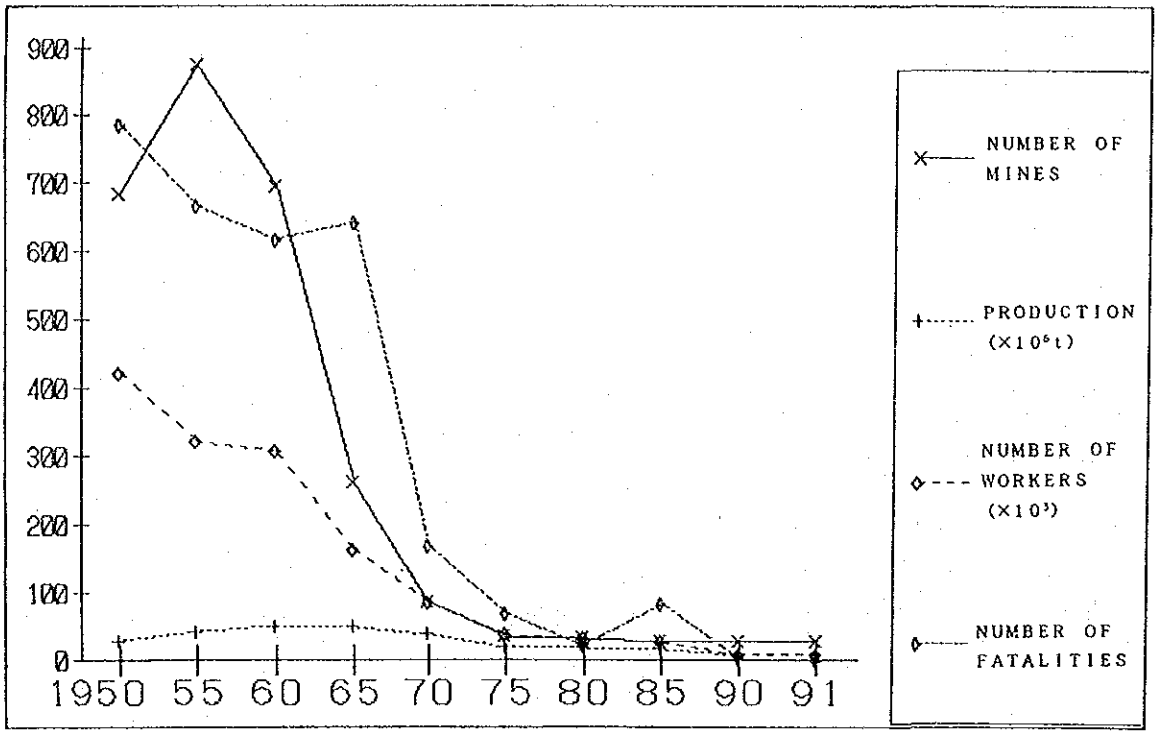
1950 55 60 65 70 75 80 85 90 91
NUMBER OF WORKERS (×10³)


784
666
616
641
170
68
22
83
2
1
800
700
600
500
400
300
200
100
0
1950 55 60 65 70 75 80 85 90 91
NUMBER OF FATALITIES


900
800
700
600
500
400
300
200
100
0
1950 55 60 65 70 75 80 85 90 91
NUMBER OF MINES
PRODUCTION (×10⁶t)
NUMBER OF WORKERS (×10³)
NUMBER OF FATALITIES

An Outline of the Mine Safety Law
(Came into effect in August 1949)

1. Purposes of the Mine Safety Law

The Mine Safety Law provides for the duties that mine owners and mine workers must observe in mines for mining safety.

Purposes
(1) To prevent danger and injury to man in mines
(2) To conserve mineral resources
(3) To preserve the facilities of mines
(4) To prevent mine pollution

Features
(1) Mine safety and production are grasped as an undividable whole.
(2) A variety of democratic systems such as a mine safety committee and a mine safety conference are established.
(3) A line of command and direction is established through the establishment of a mine safety management system.

2. Structure of the Mine Safety Law

The mine safety law provides for main matters in itself and leaves concrete provisions concerning technical matters, etc. to the following and other ordinances of the Ministry of International Trade and Industry:

Coal Mine Safety Regulation
Metal Mine etc. Safety Regulation
Petroleum Mine Safety Regulation
Certification Rules for Underground Mining Equipment
National Examination Rules for Authorized Mine Safety Engineers

3. Mine Safety Inner Rules

Each mine is obligated by law to lay down mine safety inner rules, detailing duties to be observed in accordance with natural and other conditions of the mine.

4. Mine Safety Management System

The members of the mine safety management system are a superintendent for mine safety, who is the chief official in charge of mine safety, and mine safety engineers, who perform individual mine safety duties assigned to them.

(1) Superintendent for mine safety:

An official who exercises general control over all aspects of mine safety

(2) Technical safety staffs

Mine safety manager : An official who assists the superintendent for mine safety by managing the technical aspect of mine safety

Assistant mine safety manager : An official who assists the mine safety manager

Section staff : An official who takes partial charge of technical matters about mine safety

Safety inspector of mines : An official who makes recommendations about safety to mine safety engineers and others

Assistant for safety inspector of mines :

An official who assists a safety inspector of mines

(3) Mine safety committee:

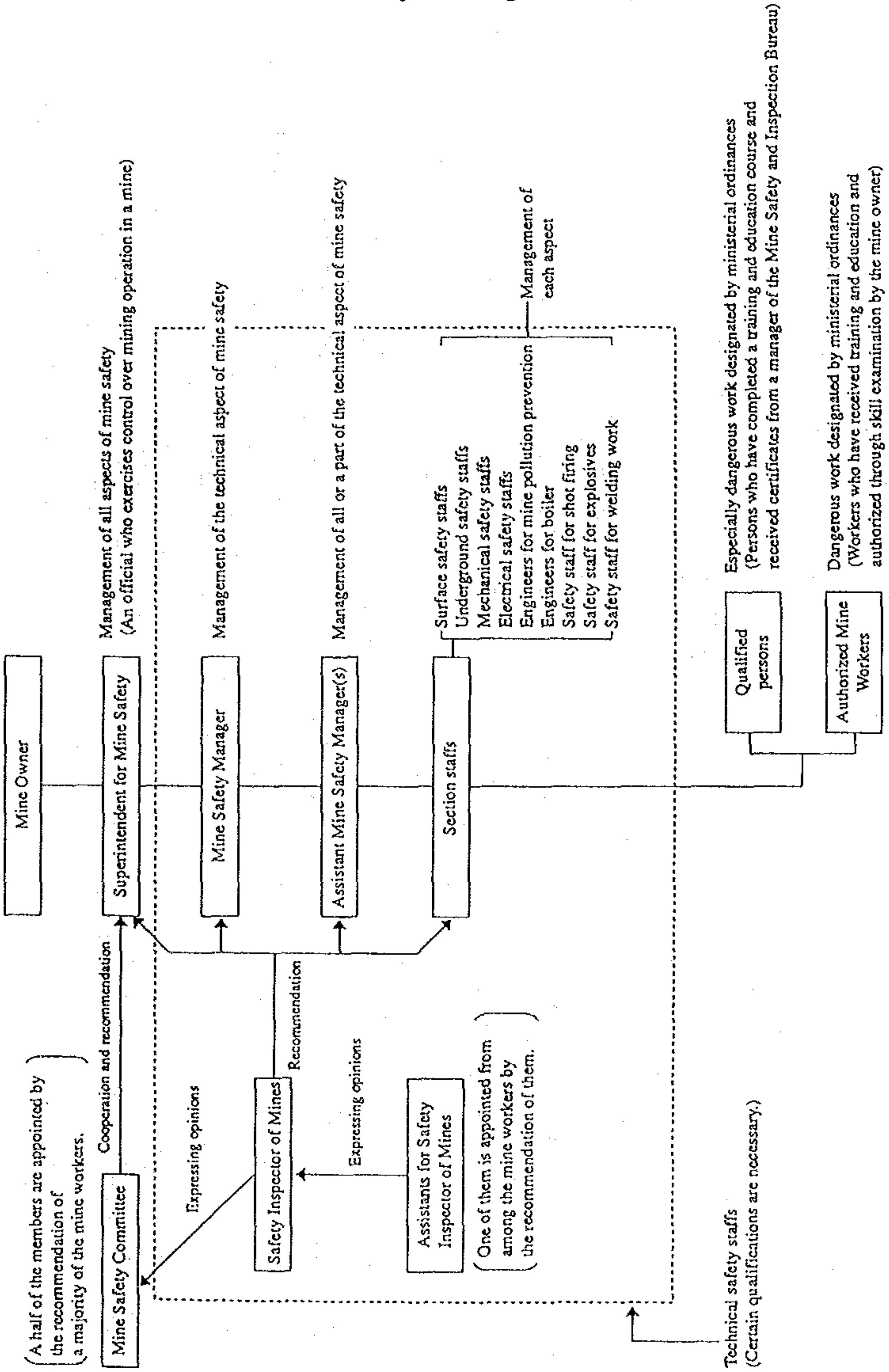
A committee that extends cooperation to the execution of the duties of the superintendent for mine safety and makes recommendations for mine safety. The committee also discusses important matters concerning mine safety, including the establishment of mine safety inner rules, the taking of anti-disaster measures, the survey of mine safety conditions and the enforcement of mine safety training and education.

5. Mine Safety Training and Education

(1) Each coal mining company must give its mine workers the safety training and education required for them to do their jobs.

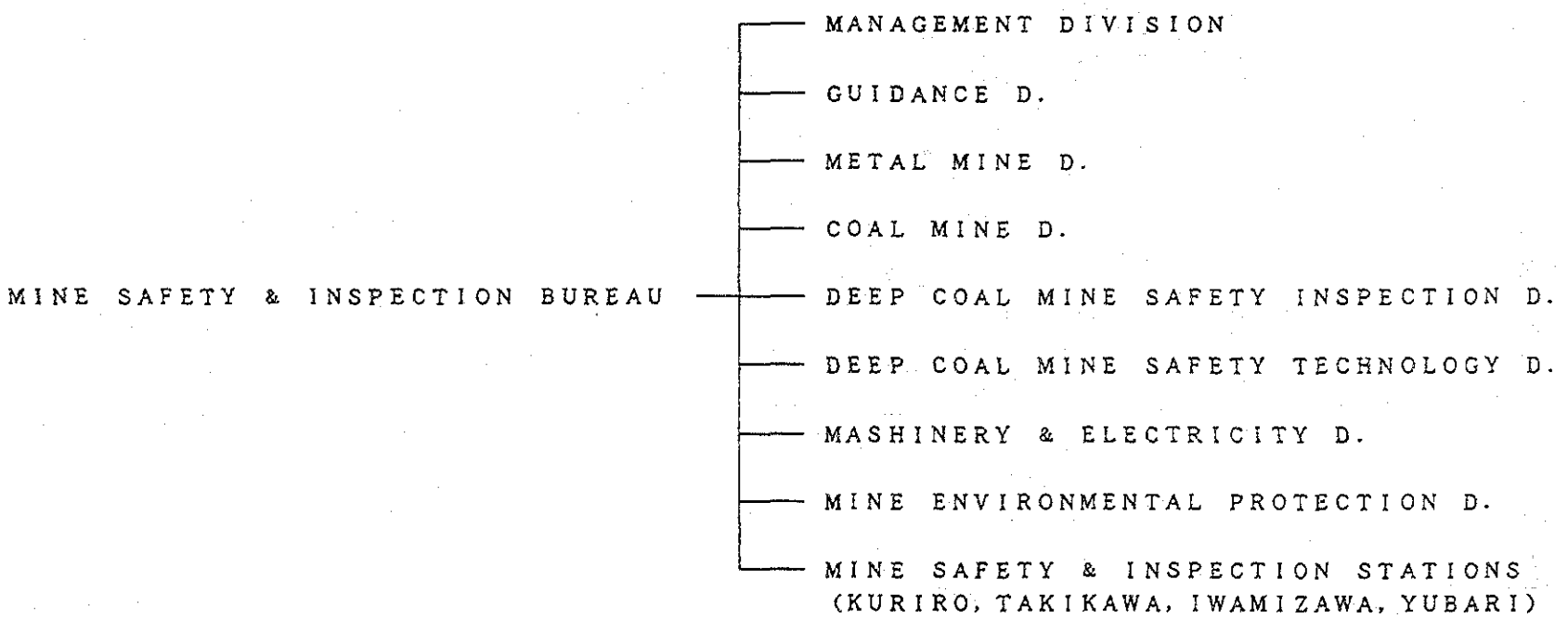
(2) Dangerous operations may be engaged in only by those workers who have received certain training and education according to the degree of dangers, such as qualified persons and authorized mine workers.

Mine Safety Management System

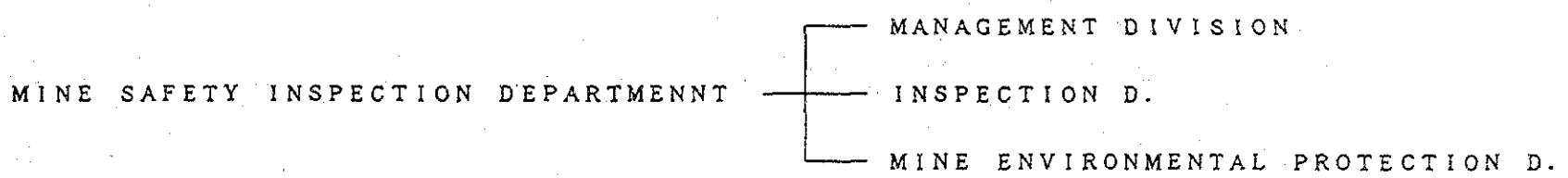


STANDARD ORGANIZATION OF MINE SAFETY AND INSPECTION BUREAU (DEPARTMENT)

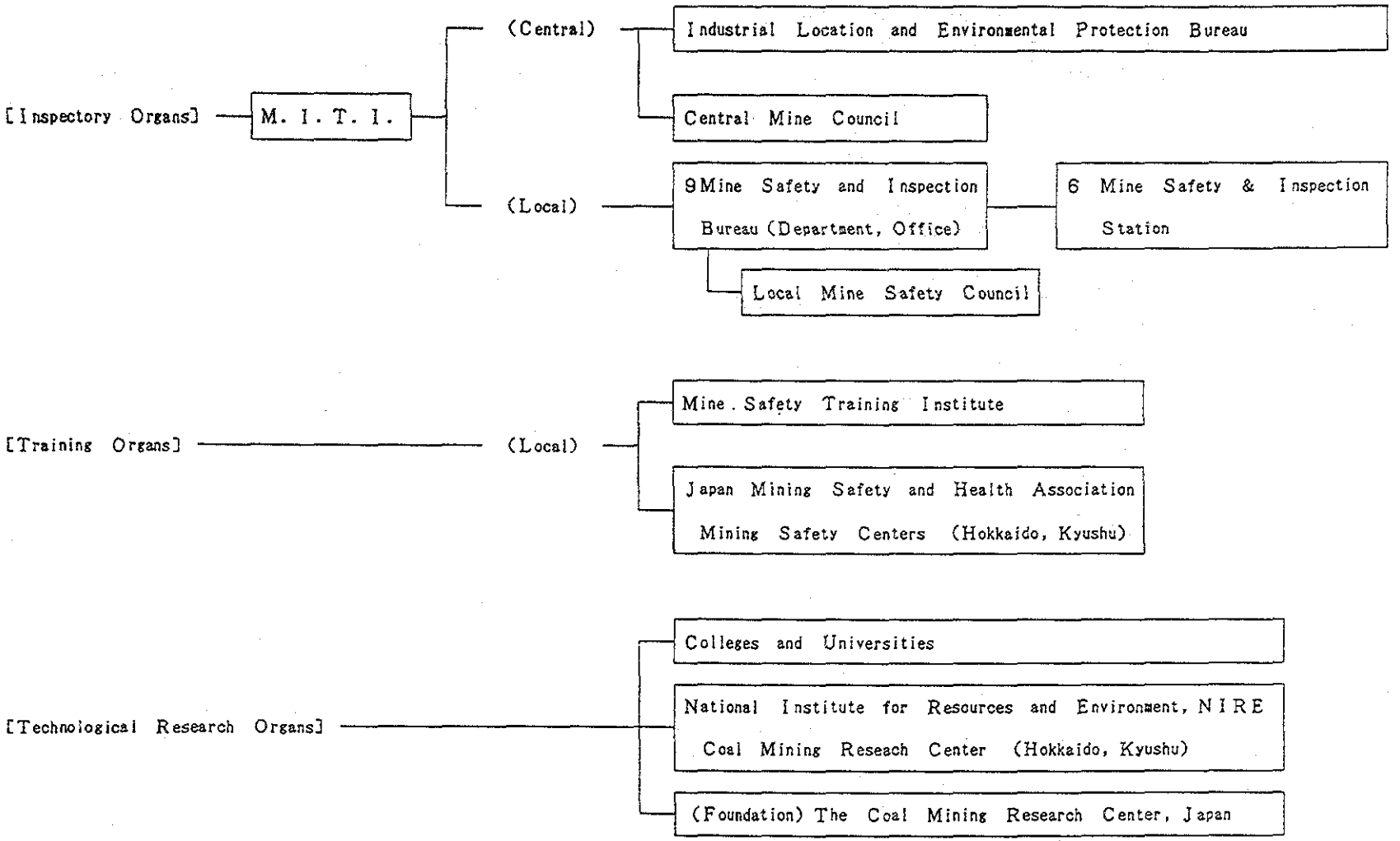
1. AN EXAMPLE FOR BUREAU



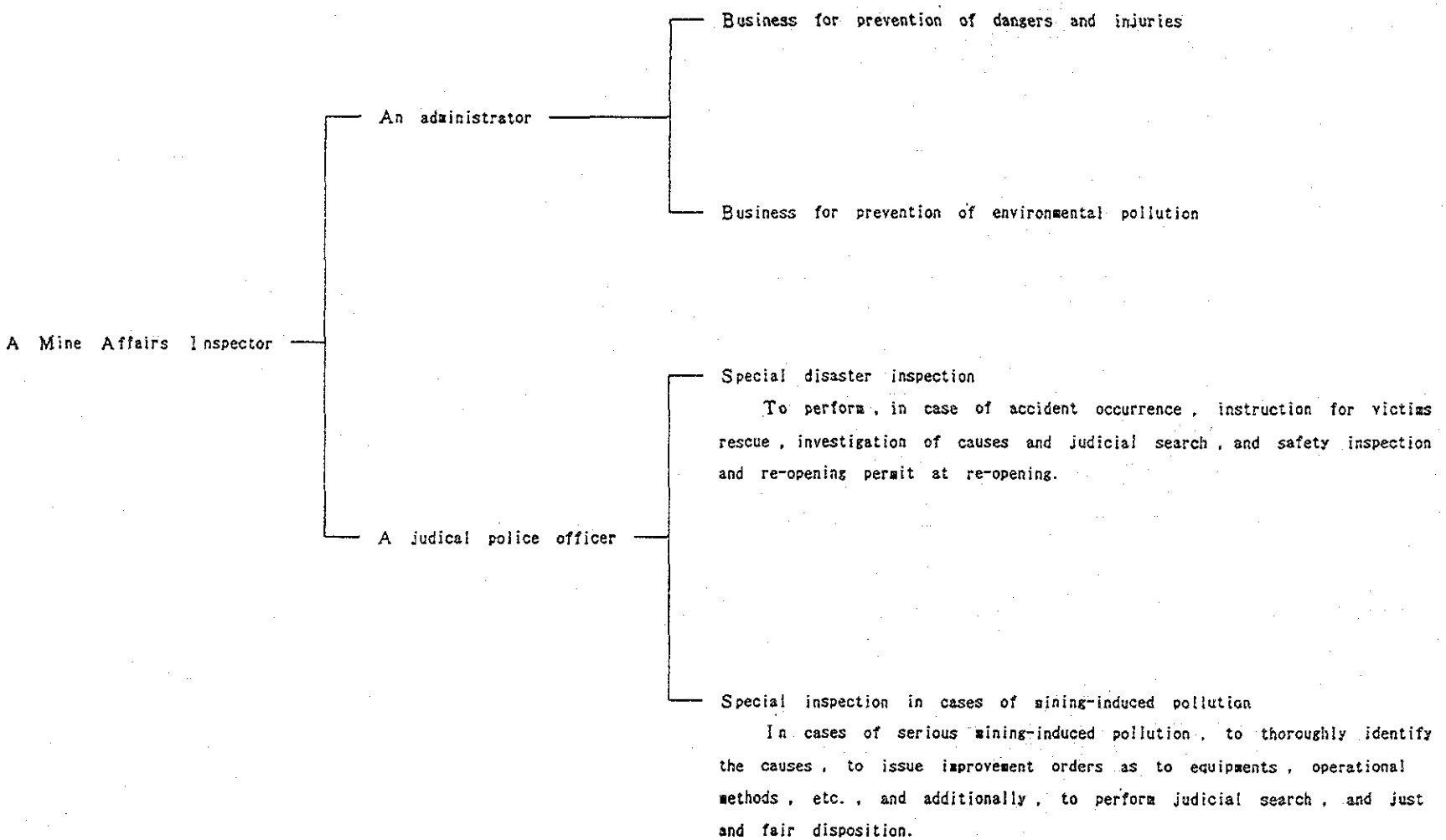
2. AN EXAMPLE FOR A DEPARTMENNT



OUTLINE OF SAFETY RELATED ORGANS



A MINE AFFAIRS INSPECTOR



General circuit inspection (Example)

1. A model coal mine

① Long wall faces …… 4
② Drift (Coal) …… 15
③ Drift (Rock) …… 15
④ Number of workers …… 1, 500
⑤ Production …… 1, 000, 000t/year

2. Method of general circuit inspection

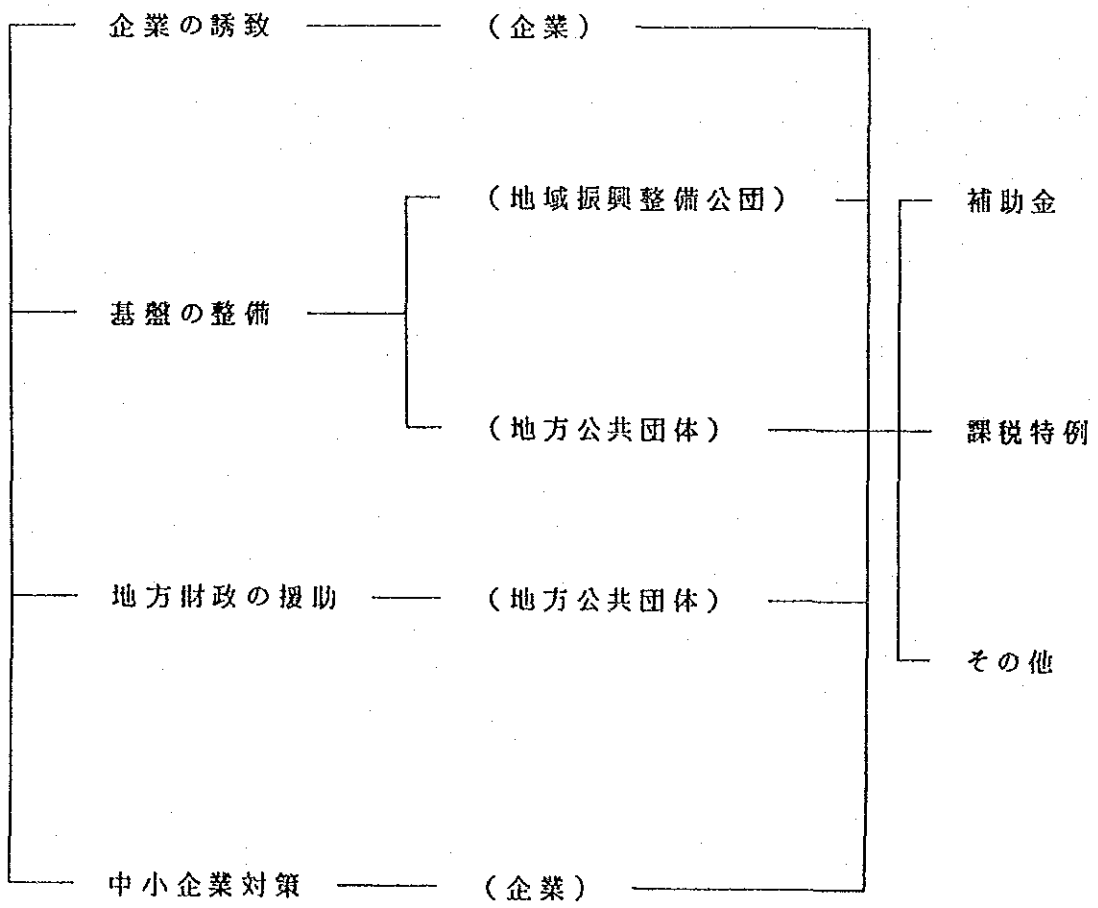
① The number of days …… 4 days

	A M	P M
The first day	START	Hearing
The second day	Inspection of entering	Hearing
The third day	underground	Hearing
The fourth day	Meeting	RETURN

② Number of inspectors …… 4

Outline of the Development of Coal Mining Areas in Japan

（産炭地域振興対策の概要）



(2)井清団員原稿

SEMINAR SUBJECTS

at

Follow-Up Survey for Ex-participants of Training Program
on
COAL MINE SAFETY

by

Takehiro ISEI

Head, System Safety Division,
Safety Engineering Department,
National Institute for Resources and Environment of Japan

From July 22 to August 10, 1992

[Contents]

INTRODUCTION

Improvement of safety in mines has been carried out repeating the "Endless Loop" shown in Figure 1. Namely, during continuous operation in a mine, some incident or accident or disaster occur occasionally due to the some cause. And then, related organization makes an investigation to find out the reason or cause of the incident/accident/disaster. After completing the investigation, the investigation results gives an information to prevent the similar incident/accident/disaster or gives an idea of technical improvement or sometimes clarify the necessity of research work for solving the safety problems. (See also Figure 10 and Figure 11 concerning with serious disasters in Japanese coal mines.)

Escaping from such endless loop is an ideal situation of safety management, however, it is not possible to get out perfectly from the endless loop in the existing circumstances. And so, the best way is to prolong the safety operation period as long as possible.

Figure 2 and Figure 3 show how Japanese coal industry has improved the safety during their operation. From Figure 2, it is obvious that Japanese industry has reduced its size for last three decade, however, note that the declining rate of curve [E] which shows the frequency rate of accidents per a million of workers is much grater than the others. In spite of reduction of production, improvement of safety has achieved steadily. This tendency is much obvious through Figure 3 in which the Frequency rates of several industry are compared each other. Figure shows that the mining industry is not the most dangerous industry not any longer. From the end of '60s quite rapid improvement in safety in mines has achieved and the mining industry gave away the worst position to the other industry now.

Prolonging of safety period in mines might be achieved through sincere effort of the person concerned and shearing of the knowledge of safety. From the thought shown above, following three items are introduced briefly;

1. Historical Trend of Development of Safety Technology for Coal Mine,
2. Similarity of Serious Disaster at Coal Mines including an example of investigation report of coal mine underground fire accident at Miike-Ariake Coal Mine Japan, and
3. Technical background of Japanese Coal Mine Safety Regulation.

1. Historical Trend of Development of Safety Technology for Coal Mine

One of the best example to see how safety technology in mines have been developed historically is to review the history of the International Conference of Safety in Mines Research Institute(ICSMRI). ICSMRI was initiated in Buxton ,UK in 1931 with participants from UK, Belgium, France, Germany and USA. The object of ICSMRI was to foster international exchange of information on the safety of underground coal mining operations and to bring together active researchers so that they could learn directly from each others' experience.

Trough the history of ICSMRI more than 60 years, 24 times meeting and plus three restricted meetings have been held as shown in Figure 4. The ideal cooperation has been kept on even through the period of the "Cold War" between western countries and eastern countries, i.e., there has been no barriers in the field of information exchange of safety in mines.

Around 20 countries are currently participate in ICSMRI in every two years and more than 100 papers are presented from wide range field for mining safety. Tendency of historical change of presented papers at ICSMRI is shown in Figure 5. The first topics of the conference were "Explosive", "Explosion Proof" and "Firedamp and Coal Dust Explosion". All of which are the predestinated subjects comes from that the purpose of the coal mining industry is to produce fossil "Fuel". How to prevent firedamp or coal dust explosion is the most primitive subject for coal mines and it is still quite important target of safety engineers in coal mine.

The other destiny of mining industries is that the working face is started from shallow and easier part of underground. And then it goes deeper part or longer part from pit mouth. As an example, the yearly change of the depth of mining industry in Japan is shown in Figure 6. Such deepening or prolonging of working place in coal mines has brought us many problems in safety accompanied with the appeared physical change in coal mines as follows;

(1) Increasing of rock pressure (rock fall, rock burst, gas outburst, etc.)
(2) Increasing of methane gas emission (firedamp explosion, gas outburst, etc,)
(3) Increasing of ventilation quantity (complex ventilation network, spontaneous combustion,etc)
(4) Increasing of transportation distance (lowering of productivity, fire caused by transportation facilities, etc)
(5) Increasing of water drainage (flooding, etc.)
(6) Increasing of utilization of electricity (underground fire,etc)
(7) Worsening of working environment (High temperature, dust, noise, etc.)

Quite many change in such factors forced to solve many problems to keep the safety level. From Figure 5, it is quite obvious that all the country related development of coal mining had to solve many subjects accompanied with the deepening or prolonging of underground working place. There is no exception of such destiny in coal mines. And so, the historically younger coal mining can learn many things from senior coal mining.

In Japan, many organization related to safety technology of coal mine are now carrying out cooperative research work or technical discussion to develop new safety technology under the "Total Plan for Development of Safety Technology" in coal mine as shown in Figure 12.

2 . Similarity of Serious Disaster at Coal Mines

As described in Chapter 1., all the mining industry have to face to the common destiny, i.e., the mining starts its activity from shallow part and then goes to deeper part of underground. This destiny requires not only safety problems but also productivity problems.

Prolonging of transportation distance at coal mines requires higher speed transportation system. In the past several years or so, there were three underground fire accidents at coal mines in Japan, US and USSR(Ukraine) as follows;

(1) Jan 18, 1984, Mitsui-Miike Ariake Mine(Japan), Death 83, Injured 16
(2) Dec 19, 1984, Wiberg Mine(US), Death 27
(3) Jun 29, 1991, Yuzhno-Donbass Mine(USSR,Ukraine), Death 32

Outline of these accident are shown in Figure 7(Ariake), Figure 8(Wilberg) and Figure 9(Donbass). From the investigation materials of these accidents it is possible to find many common factors or similar situations which shows us future preventive method of similar accident.

Main similar points of these accidents are as follows;

(1) Initiation of fire (ignition source) : Friction heat of belt conveyer
  a) Ariake : Friction between carrier roller and roller post
  b) Wilberg : Friction of bearing parts
  c) Donbass : Friction between driving drum and belt
(2) Expansion of fire : Exist of coal dust

Friction heat ignited coal dust deposited near the friction point of belt conveyer and then the fire spread over belt, gallery timber and other flammable materials along gallery. Usually, fine coal dust starts its combustion at quite low temperature such like less than 200 degree in centigrade. Some of them are ignited even such less 100 degree or so.

(3) Main burned materials : belts, timber, cables, etc.
(4) Place of fire outbreak : Intake gallery

Due to ventilation, fire gas, fume or smoke had been brought to downward wide working area where many victims were working. Blacken gas or air with fire fume came from upward, and so, there was quite few choice to find the best evacuation route.

(5) Cause of death of victims : Toxic fume(CO, HCl, phosgene), Deficiency of oxygen
(6) Problem during fire fighting :
  a) Failure of initial extinguishing : Lack of fire extinguisher
  b) Lack of water :

Water pressure of pipe line were dropped extremely just after start of draining (Ariake, Donbass). In case of wilbwerg, the mine located at mountain side, so, the minimum necessary water for operation was pumped up from valley.

Quite duplicated similarity of underground fire accident at different countries shows us importantness to learn the experience of accident of other countries. The teachings of accident experience have to be sheared with all mining related peoples.

To learn the teachings of accident, one best way is to examine the investigation report of accident. As an examples, the contents of the accident investigation report by the Investigation Committee for Underground Fire Accident at Miike(Ariake) are shown below.
(Detail of the report will be introduced through the seminar.)

REPORT OF INVESTIGATION COMMITTEE FOR UNDERGROUND FIRE ACCIDENT AT MIIKE COLLIERY

SEPTEMBER, 1984

BY

INVESTIGATION COMMITTEE FOR UNDERGROUND FIRE ACCIDENT AT MIIKE COLLIERY

INTRODUCTION

On January 18, 1984, an underground fire accident has broken out at Ariake Area in Miike Colliery of the Mitsui Coal Mining Co. Ltd., and 83 miners were lost and 16 miners were seriously injured due to the accident. Based on the request of the Minister of the Ministry of International Trade and Industry (MITI), the Investigation Committee has made field survey, experiments related to the cause and analysis for the purposes of the inquiring the cause of the accident and also of the recommendation for future improvement. The committee had several meetings to discuss on the investigation results. This document is the final report of the investigation results of the committee.

1. Members of the Investigation Committee

[Committee member]

Chairman : S. I., Honorary Professor of Tokyo University (Mining)

Member : J. I., Professor of Kyushu University (Mining)
Y. U., Professor of Yokohama Institute of Technology (Safety Engineering)
S. O., Director General of National Institute for Resources and Environment(NIRE), MITI (Ventilation)
R. S., Director of Labor Environment, Industrial Medical Research Institute of Ministry of Labor (Combustion reaction)
J. T., Director of Coal Mining Safety Research Center, Kyushu, NIRE, MITI (Spontaneous Combustion)
B. H., Professor of Waseda University (Mining Machinery)
Z. H., Professor of Tokyo University (Mining)
N. M., Director General of Industrial Safety Research Institute, Ministry of Labor(Laborers' safety)

[Specialist Committee Member]

K. A., Section Head of Safety Division of Kyushu Electrical Safety Association(Electricity)
T. I., Section Head of Experimental Coal Mine, NIRE, MITI (Underground Fire)
K. U., Professor of Kyushu University (Ventilation)
M. U., Advisor of Coal Mining Research Center (Underground Fire)
M. T., Coal Mining Research Center (Electricity)
S. M., Section Head of Coal Mining Safety Research Center, Kyushu (Chemical Analysis and Combustion)
S. Y., Section Head of NIRE (Underground Fire)

2. Discussion Progress of the Committee

(1)	26, January, 1984	: 1st Meeting (at Tokyo)
(2)	30,31 January	: 2nd Meeting (Field survey and discussion)
(3)	10, February	: Field survey by selected members
(4)	16, February	: Field survey by selected members
(5)	23-25 February	: 3rd Meeting (Field survey and discussion)
(6)	1, March	: Field survey by selected members
(7)	3, March	: 4th Meeting (at Tokyo)
(8)	10, March	: Meeting of Members from Kyushu Area
(9)	12, March	: 5th Meeting (at Tokyo) "Presentation of the Interim Report"
(10)	29, March	: Field survey by selected members
(11)	30, March	: Meeting of Members from Kyushu Area
(12)	16, April	: 6th Meeting (at Tokyo)
(13)	28, April	: Field survey by selected members
(14)	27, June	: Meeting of Members from Kyushu Area
(15)	19, July	: 7th Meeting (at Tokyo)
(16)	24, August	: Meeting of Members from Kyushu Area
(17)	29, August	: Meeting of Members from Tokyo Area
(18)	17, September	: Meeting of Members from Kyushu Area
(19)	19, September	: Meeting of Members from Tokyo Area
(20)	20, September	: 8th Meeting (at Tokyo) "Presentation of the Final Report"

Contents of the Final Report of the Committee

1. Outline of operation
 (1) Name of Coal Mining Company and Name of Colliery
 (2) Location of Colliery
 (3) Name of the mining right owner
 (4) Outline of operation
  [1] Location and history
   a) Location
   b) History
  [2] Geological condition
  [3] Operation condition
   a) Underground structure
   b) Mining operation
   c) Ventilation condition
   d) Water drainage
   e) Transportation condition
   f) Condition of safety facilities

2. Outline of the accident
 (1) Date and time of the fire accident
 (2) Location of break out of fire
 (3) Number of victims and cause of suffering
 (4) Bounds of burned gallery area
 (5) Flow route of fire fume, smoke, CO and etc.
 (6) Details of the fire accident

3. Cause of the accident
 (1) Location of break out of fire and the cause of break out of fire
  [1] Investigation to identify the location of break out of fire
  [2] Cause of break out of fire
 (2) Factors of damage expansion

[1] Detection of break out of fire
[2] Report of detection and indication of order
[3] Fire fighting activities
[4] Evacuation

4. Countermeasure for prevention of similar accident
(1) Urgent countermeasure
[1] Prevention of outbreak of fire
[2] Earlier detection of fire and report of the situation
[3] Reinforcement of report and commandment system
[4] Fire fighting
[5] Evacuation training and others
(2) Future problem
[1] Matters to be discussed generally for new application and possibility of application
[2] Matters to be subjected to future research work

Attached Materials
Fig. 1 : Skeleton of structure of Miike Colliery
Fig. 2 : Name of galleries
Fig. 3 : Ventilation map
Fig. 4 : Bounds of burned gallery area
Fig. 5 : Structure and location of No.2 and No.3 ventilation regulation gate
Fig. 6 : Detail of No.3 ventilation regulation gate
Fig. 7 : General structure of belt conveyer
Fig. 8 : Abnormal friction between carrier roller and roller stand
Fig. 9 : Location of safety facilities (Smoke detector, CO sonsor, Rescue shelter)
Fig. 10 : Location of fire fighting facilities
Fig. 11 : Location of the fatal remains
Table 1 : Table of fatalities

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3. Technical background of the Japanese Coal Mine Safety Regulation

As shown in the former statistical data of safety situation at Japanese coal mines, recent improvement is remarkable. To overcome the such improvement of safety in coal mines, the role of the Japanese Coal Mine Safety Regulation can not be ignored. Contents and brief technical descriptions are as follows;

[Note] This document is tentatively translated from an extract of the Japanese Coal Mine Safety Regulation for the purpose of explanation or introduction of the concept of the regulation to foreign safety engineers briefly. And so, exact refer of the regulation is only allowed through the Japanese original regulation.

Japanese Coal Mine Safety Regulation

Chapter 1. General rules
Paragraph 1. General rules
Article 2. Definition of words
5. "Explosive coal dust" is defined by the coal dust which is generated from the coal seam with the volatile matter content more than 11%.
Paragraph 2. Kind of coal mines
Article 5. Coal mines are divided into "Type A(Ko-shu) coal mines" and "Type B(Otsu-shu) coal mines".
2. Type A(Ko-shu) coal mines are designated by the Minister of the Ministry of International Trade and Industry in case the condition of the mine correspond to following items;
1. The concentration of flammable gas in the total exhaust exceeds 0.25%.
2. The concentration of flammable gas in the exhaust from working area exceeds 0.5%.
3. The concentration of flammable gas exceeds 3% at passage or excavation area in case the ventilation fan is stopped for one hour.
3. Type B(Otsu-shu) coal mines are all the other coal mines except for Type A(Ko-shu) coal mines.
Paragraph 3. Safety Manager and Safety Engineers
Article 12 (Quantification of safety engineers)
Paragraph 4. Safety Education
Paragraph 5. Mining workers
Paragraph 6. Safety Committee
Paragraph 7. Safety Provisions(Inner rules) of Mining Company
Paragraph 8. Approval and Notification
Paragraph 9. Official performance tests
Paragraph 10. Safety map
Paragraph 11. Report
Paragraph 12. Rerief aid in case of emergency

Chapter 2. Restriction of machinery and instruments
Paragraph 1. Restriction items
Article 78. Designated machinery and instruments have to be undergone official inspection test.
(1. Explosive, 2. Safety Sheath, 3. Exploder, 4. Illumination instruments, 5. Electrical machinery or electrical instruments, 6. Machinery or instruments which generates high temperature heat or friction spark, 7. Electrical cables, 8. Internal combustion engine, 9. Gas measuring device, 10. Dust measuring device, 11. Anemometer, 12. Automatic inflammable gas

alarm, 13. Rescue breathing apparatus, 14. Apparatus designated by the Minister of MITI)

Paragraph 2. Utilization of materials or instruments for use in underground

Chapter 3. Ventilation and underground gas

Paragraph 1. General rule

Article 85. The items required to set details in the Safety Provision(Inner rules of the company).

(1. Prevention of respiratory dust, 2. Disposition in case for rapid drop in atmospheric pressure, 3. Disposition in case for stop of main fan, 4. Description of ventilation book, 5. Description of safety map, 6. Management of ventilation gallery, 7. Auxiliary ventilation, 8. Kind and management gas measuring device, 9. Management and installation of automatic gas alarm, 10. Restriction of gas quantity and exhaust of gas, 11. Establishment of precaution area against gas outburst, 12. Hazard prevention of gas outburst against gas outburst by gas drainage or advanced boring, 13. Evacuation system for mining worker and air supply system, 14. Prevention of hazard due to static electricity, 15. Discipline of fire ignition source)

Paragraph 2. Underground air

Article 86. The concentration of oxygen at working place should be higher than 19% and the concentration of Carbon dioxide should be less than 1%.

Article 87. The concentration of flammable gas in main exhaust air flow should be less than 1.5%.

Article 88. The concentration of flammable gas should be less than 1.5% at underground working place and less than 2% at underground passage.

Article 89. The temperature of working place should be less than 37 degree in centigrade.

Article 90. The quantity of ventilation at underground working place have to be decided allowing for the numbers of workers, gas emission quantity, possibility of occurrence of spontaneous combustion, temperature, humidity and others. Exhaust of blast fume have to be also considered.

Article 91. Total ventilation quantity at the inlet of intake shaft should be grater than that which enable to supply 3 cubic meter per one person per one minute.

Article 92. The maximum ventilation speed in underground gallery should be less than 450m/min.

Paragraph 3. Ventilation facilities

Article 103. 3. The distance between heading face and air duct for auxiliary ventilation should be less than 7m.

Paragraph 4. Measurement of underground air

Article 116. Safety engineer have to measure the ventilation quantity at the total intake entrance and total exhaust exit every day and at main branch of intake gallery and exhaust gallery in every 7 days.

Article 117. 3. The ventilation speed and quantity have to be measured at all general location underground in every 30 days.

Article 119. Temperature and relative humidity have to be measured twice a month.

Paragraph 5. Underground gas

Article 121. Safety engineer have to measure the concentration of flammable gas once every one working shift at winning face, heading and other working place in case of emission of flammable gas is expected.

Article 122. 1. Flammable gas automatic alarm have to be installed at winning face, heading and the place of electrical installation where the concentration of flammable gas exceed 1% ordinarily.

3. The alarm have to install the automatic cut off function of

all electricity of the related area, in case the alarm detect flammable gas more than 1.5%.

Article 124. In case the concentration of flammable gas exceeds 1.5% at underground working area, safety engineer have to cut off all electricity of related area and have to order all the workers there to evacuate from hazardous area concerned.

Paragraph 5-2. Prevention of hazard due to gas outburst

Article 128-2. The owner of mining right have to designate the gas out burst precaution area in case the working area locates around hazardous area of gas outburst.

Article 128-3. The advanced boring have to be carried out prior to heading of gallery at the gas outburst warning area.

Article 128-4. In case excavation at the gas outburst area is attempt, gas drainage in enough quantity and pressure based on the pre-estimation have to be done prior to winning.

Article 128-5. In case gallery heading locates around the gas outburst warning area, the exhaust from the heading is not allowed to pass through the long wall winning face.

Article 128-6. Upward gallery heading is not allowed at the gas outburst warning area.

Article 128-7. Suitable local air supply system have to be installed at near position of working place in the gas outburst warning area.

Paragraph 5-3. Prevention of hazard due to static electricity

Article 128-11. At the underground place designated by the Director General of the Mine Safety Inspection Bureau, following procedure have to be taken to avoid hazard due to static electricity.

1. Treated material against electrification have to be used and grounding or water spraying or other suitable procedure have to be taken in case hazard due to static electricity is expected.

Paragraph 6 Restriction of use of naked fire

Chapter 4. Coal dust

Paragraph 1. General rule

Article 137. Detail of following items for prevention of coal dust should be indicated in the safety provisions(Inner rules) of the company;

1. Cleaning of coal dust
2. Method of water spraying and rock dust spraying
3. Installation and management of coal dust

Article 138-2. For the purpose of prevention of coal dust explosion, the safety engineer have to follow the next rules;

1. The safety engineer have to make a inspection tour every day to the place or area where the explosible coal dust exists or the explosible coal dust is generated and have to check the situation of coal dust and the barrier for prevention of propagation of coal dust explosion. All the inspected results should be written on daily report book.
2. At a constant interval, coal dust sample have to be subjected to analysis to examine the contents of inert material for the purpose of identification of rock dust spraying.

Paragraph 2. Treatment of coal dust

Article 139. Coal dust in the transportation gallery have to be cleaned up at a constant interval.

Article 141. To suppress generation and dispersion of coal dust, water spray or water injection against coal seam have to be carried out at coal winning area using excavation machinery or coal pick, area near blasting face, coal loading or reloading place, underground coal storage and coal loaded on tram cars.

Article 142. Rock dust have to be sprayed at all the place where coal dust is deposited.
Required rock dust quantity have to be derived by using following equations.
(1) In case the concentration of flammable gas is less than 1.0%;

$$R \geq C \times [(N-(a+b))/(100-(a+b))] \times 100$$

$$N = ((V-10)/V) \times 100$$

where R : Ratio of rock dust spraying(%)
N : Contents of inert material(%) (N = 50 in case N < 50)
V : Contents of volatile matter of coal dust(%)
a : Moisture of sample deposited on the place where rock dust is sprayed(%)
b : Contents of ash of sample deposited on the place where rock dust is sprayed(%)
C : Constant
C = 1.00 for z >= 85
C = 1.03 for 85 > z >= 75
C = 1.06 for 75 > z >= 65
C = 1.08 for 65 > z >= 55
C = 1.10 for 55 > z >= 45
z : Contents of fine particle in the used rock dust(%)

(2) In case the concentration of flammable gas is grater than 1.0%;

$$R' \geq C \times [(N'-(a+b))/(100-(a+b))] \times 100$$

$$N' = [1.1 \times N/(0.1 \times N+100)] \times 100$$

where R' : Ratio of rock dust spraying(%)
N' : Contents of inert material(%) (N = 50 in case N < 50)
N, a, b and C are same as above.

Paragraph 3. Prevention of propagation of coal dust explosion

Article 146. For the purpose of prevention of propagation of coal dust explosion, barriers or other facilities with following capacity have to be installed at main galleries, entrance and exit of working area and other necessary area.
1. Barrier with capacity of 0.1 cubic meter of water or rock dust per 1 square meter of gallery cross section
2. Dens rock dust spray area where rock dust of more than 0.3 cubic meter per 1 square meter of gallery cross section
3. Facilities permitted by the director general of the Inspection Bureau

Article 147. In case of necessary, for the purpose of prevention of propagation of coal dust explosion, special type barriers with capacity of 0.4 cubic meter of water or rock dust per 1 square meter of gallery cross section have to be installed at entrance and exit of coal winning area.

Article 148. Barriers have to be easy to turn over by blast impulse of explosion and water or rock dust should disperse all the cross section of gallery.
2. Interval of barriers have to be equal at the interval between 1 m to 30 m.
3. The thickness of rock dust on the floor of dens rock dust area should be grater than 10 cm.

Chapter 5. Spontaneous combustion

Paragraph 1. General rule

Article 150. Next items have to be indicated in the provision rule of the company for the purpose of safety for spontaneous combustion.
1. Detection method of spontaneous combustion
2. Excavation method of coal seam with high apprehensions of spontaneous combustion
3. Disposition method or order which have to be done at the area with high

apprehensions of spontaneous combustion
4. Extinguish method and sealing method
5. Disposition method or order after extinguishing or sealing

Article 151. Safety engineer have to measure temperature, humidity and gas at the area with high apprehensions of spontaneous combustion more than one times in a day. Odor have to be also inspected carefully. The safety engineer have to be careful on the trend change of measured or inspected results. Measured or inspected results have to be written in the daily report book.

Paragraph 2. Prevention of spontaneous combustion and Extinguishing

Article 152. Fire extinguishing facilities have to be installed around area with high apprehensions of spontaneous combustion. Material for temporary sealing have to be prepared prior to excavation of coal.

Chapter 6. Rock fall and collapse

Paragraph 1. General rule

Paragraph 2. Support and others

Paragraph 3. Examination of roof

Paragraph 3-2. Rock burst

Article 166-2. Improvement or change of excavation method of coal have to be done incase of excavation of coal seam with high apprehensions of rock burst.

Article 166-3. Around the area with high apprehensions of rock burst, safety engineer have to check once or more a day the condition of rock pressure. In case the safety engineer find an abnormal situation, he has to report the situation to the safety manager.

Paragraph 4 Open cast winning place

Chapter 7. Explosive and blasting

Paragraph 1. General rule

Article 170. Next items have to be indicated precisely in the provision rule (Inner rules) of the company for the purpose of safety for blasting.

1. Temporary storage at near place of blasting
1-2. Electrical conduction test method
2. Management of exploder and leading wire
3. Method of cap and fuse blasting
4. Long bore hole blasting
4-2. Electrical blasting method or other blasting methods
5. Standard of bore holes
6. Loss, theft or finding of explosive or blasting supplies
7. Description method of daily report book of blasting

Paragraph 2. Treatment of explosive

Article 174. (Standard of surface explosive magazine)

Article 175. (Standard of underground explosive magazine)

Paragraph 3. Blasting

Article 184-3. Only quantified engineer of blasting is allowed to carry out blasting.

Article 187. Blasting is not allowed at the area where the concentration of flammable gas exceeds more then 0.5%. However, in case the electrical delay blasting or the electrical instantaneous blasting is carried out, the allowable concentration of flammable gas increased up to 1.0% and 1.5% respectively.

5. Blasting method at the warning area of gas outburst have to follow next riles;

1. Blasting have to be carried out only by electrical initiation after evacuation of all workers to safe area.

2. Initiation of blasting have to be carried out by electrical exploder in the safety facility located intake side of blasting.
3. Until the risk of gas outburst is reduced sufficiently, blasting safety engineer can not allow workers to approach blasting area.
4. Explosive with safety grade Eq-S or more have to be used for blasting.

Chapter 8. Electricity
Paragraph 1. General rule
Article 196. Electrical facilities can not be installed around the area where the concentration of flammable gas ordinary exceeds 1.5%.
Paragraph 2. Grounding
Paragraph 3. Protection against for over current
Paragraph 4. Motor and attachment
Paragraph 5. Underground wiring
Paragraph 6. Aerial wiring type electrical rail way
Paragraph 7. Underground illumination
Paragraph 8. Application of the Ministerial Ordinance for the technical standard of electrical facilities

Chapter 9. Transportation
Paragraph 1. General rule
Paragraph 2. General safety apparatus
Paragraph 3. Transportation of personnel
Paragraph 4. Transportation by locomotive

Chapter 9-2. Mining vehicles and automobiles
Paragraph 1. General rule
Paragraph 2. Structure
Paragraph 3. Inspection
Paragraph 4. Prevention of hazard during use of mining vehicles and automobiles
Paragraph 5. Mining road and galleries

Chapter 10. Underground passage and working place
Paragraph 1. General rule
Paragraph 2. Passage
Paragraph 3. Working place

Chapter 11. Fires
Paragraph 1. General rule
Paragraph 2. Prevention of underground fires
Article 288. Underground winding engine room, compressor room,pump room, fan room and transformer room have to be built by fire proof structure.
Article 289. Fire proof structure is defined by the structure coated by mortar with wire net or plaster. Fire resistant structure is defined by the structure constructed by concrete or bricks.
Article 289-2. Automatic fire extinguishing system have to be installed at underground compressor room, oil or wax storage, main transformer room and room for main electric switch with insulation oil.
Article 289-3 Fire hydrants have to be installed at least in every 100 m in belt conveyer gallery, locomotive(with internal combustion engine or aerial wiring type) driven gallery, wired gallery for electricity power, area where electrical machinery with insulation oil and driving engine for belt conveyer are installed.
2. The capacity of each fire hydrant should be grater than 300 liter per

minute.
Article 293. All buildings or structure located within 30 m from pit mouth of gallery should be fire proof structure.
Article 294. All the tree with in 30 m from pit mouth of gallery have to be felled down.
Paragraph 3. Treatment of fire on surface

Chapter 11-2. Central monitoring
Paragraph 1. General rule
Paragraph 2. Acquiring of central monitoring room

Chapter 12. Surface facilities and drainage facilities
Paragraph 1. General rule
Paragraph 2. Tippler, coal washing plant and other surface working place
Paragraph 3. Boiler
Paragraph 3-2. Special type boiler
Paragraph 4. Compressor
Paragraph 5. High pressure gas
Paragraph 6. Acetylene gas welder
paragraph 6-2. Gas assemble type welder
Paragraph 7. Crane
Paragraph 8. Ropeway
Paragraph 9. General machinery
Paragraph 10. Ventilation, illumination and temperature of working place
Paragraph 11. Surface passage and working place
Paragraph 12. Drainage facilities
Paragraph 13. Gas inducement facilities

Chapter 12-2. Prevention of pollution and hazard
Paragraph 1. General rule
Paragraph 2. Prevention of pollution due to excavation of ground
Paragraph 2-2. Prevention of pollution due to waste of mining industry
Paragraph 3. Prevention of pollution due to accumulation of waste rock or sediment
Paragraph 4. Special mining plan for the place where the hazard is expected due to mining
Paragraph 5. Prevention of pollution due to smoke ot soot
Paragraph 5-2. Prevention of pollution due to dust
Paragraph 6. Prevention of pollution due to mining water or drainage
Paragraph 7. Prevention of noise pollution
Paragraph 8. Prevention of vibration pollution

Chapter 13. Restriction of excavation
Paragraph 1. Special mining plan for underground beneath sea bottom
Paragraph 2. Excavation beneath sea bottom
Paragraph 3. Approach to old galleries
Paragraph 4. Report

Chapter 14. Notification of contract work

Chapter 15. Miscellaneous rule

Supplementary rules

Appendix tables
Format

Flow Chart of Safety Achievment in Mine

by T. Isei

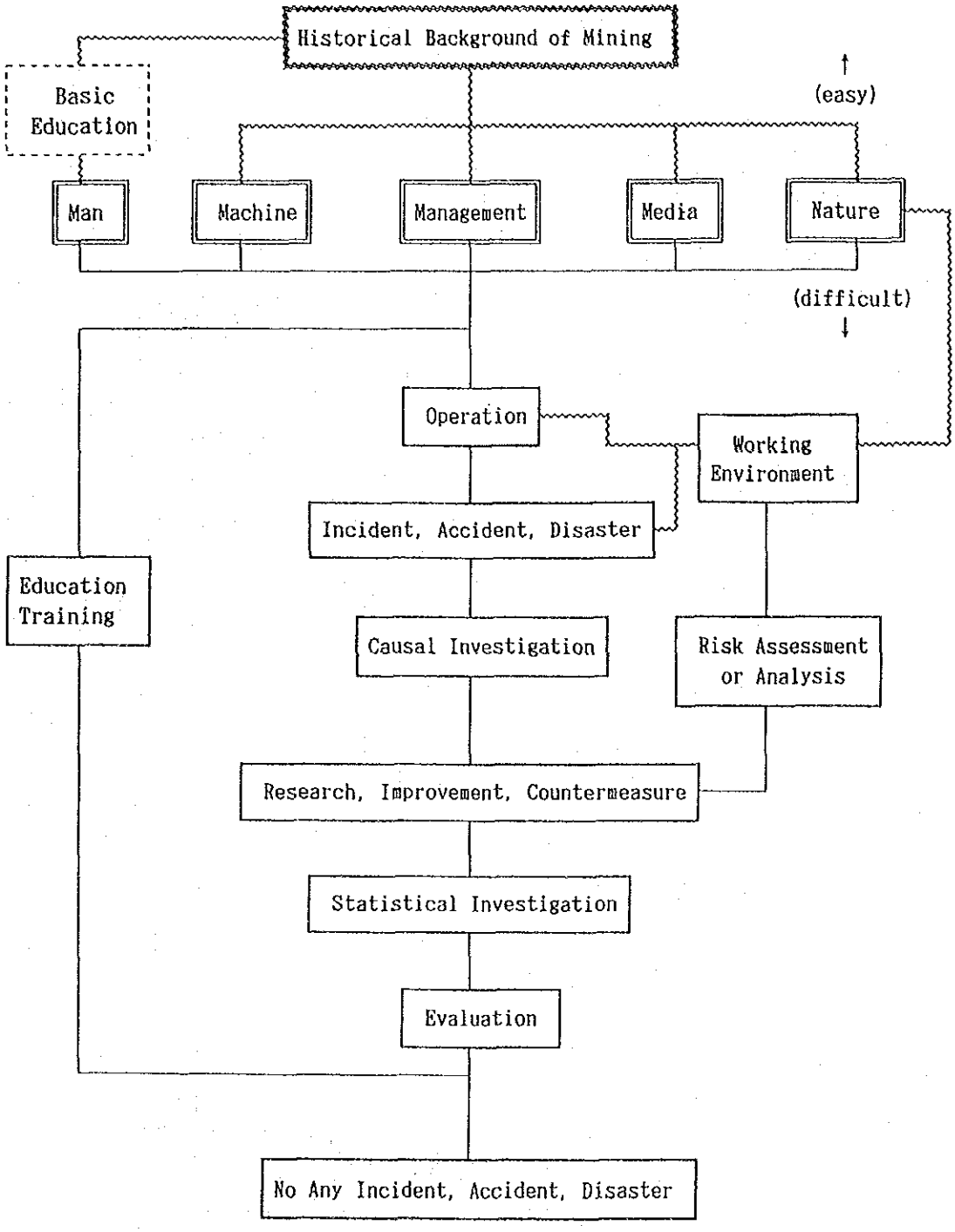


Figure 1

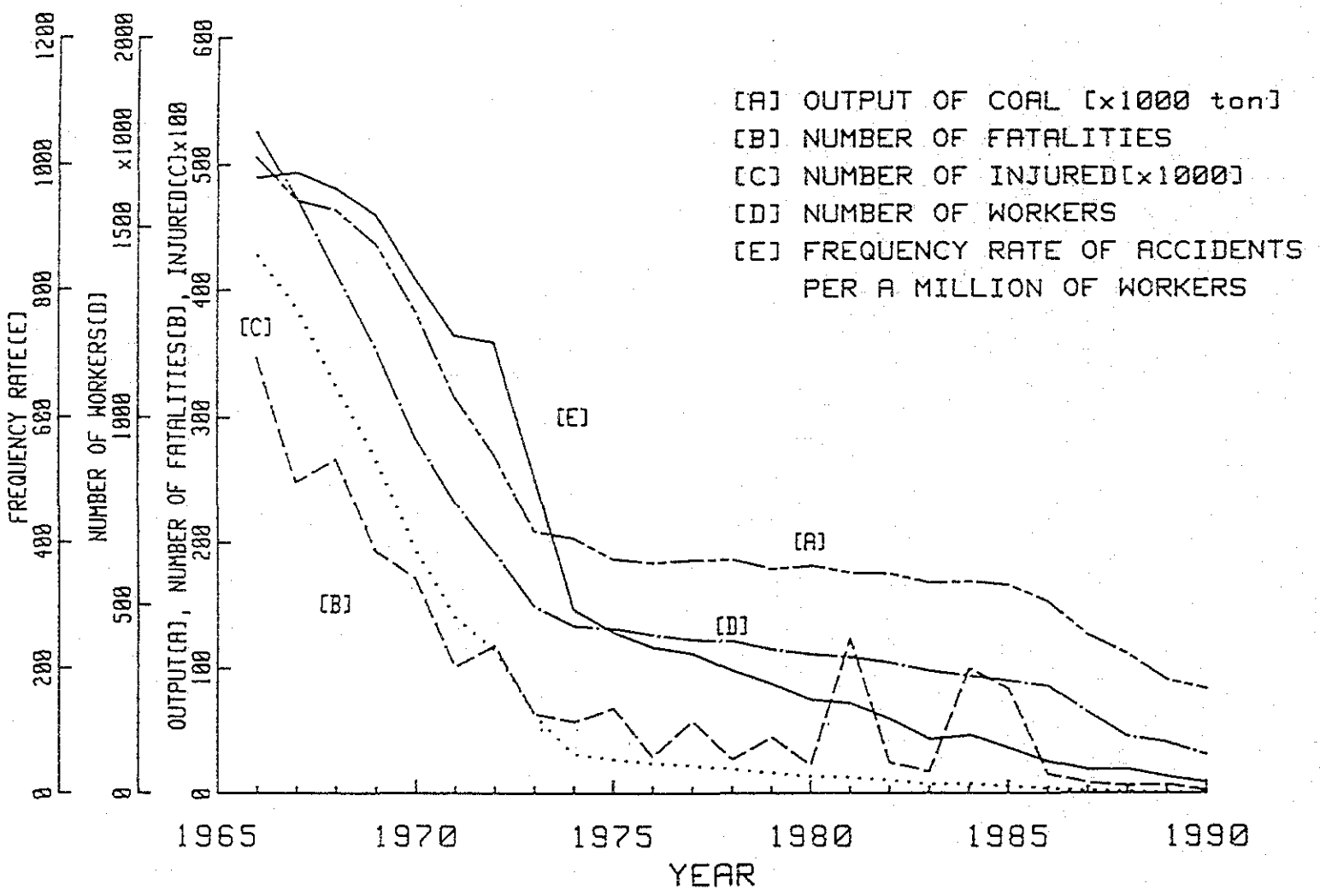
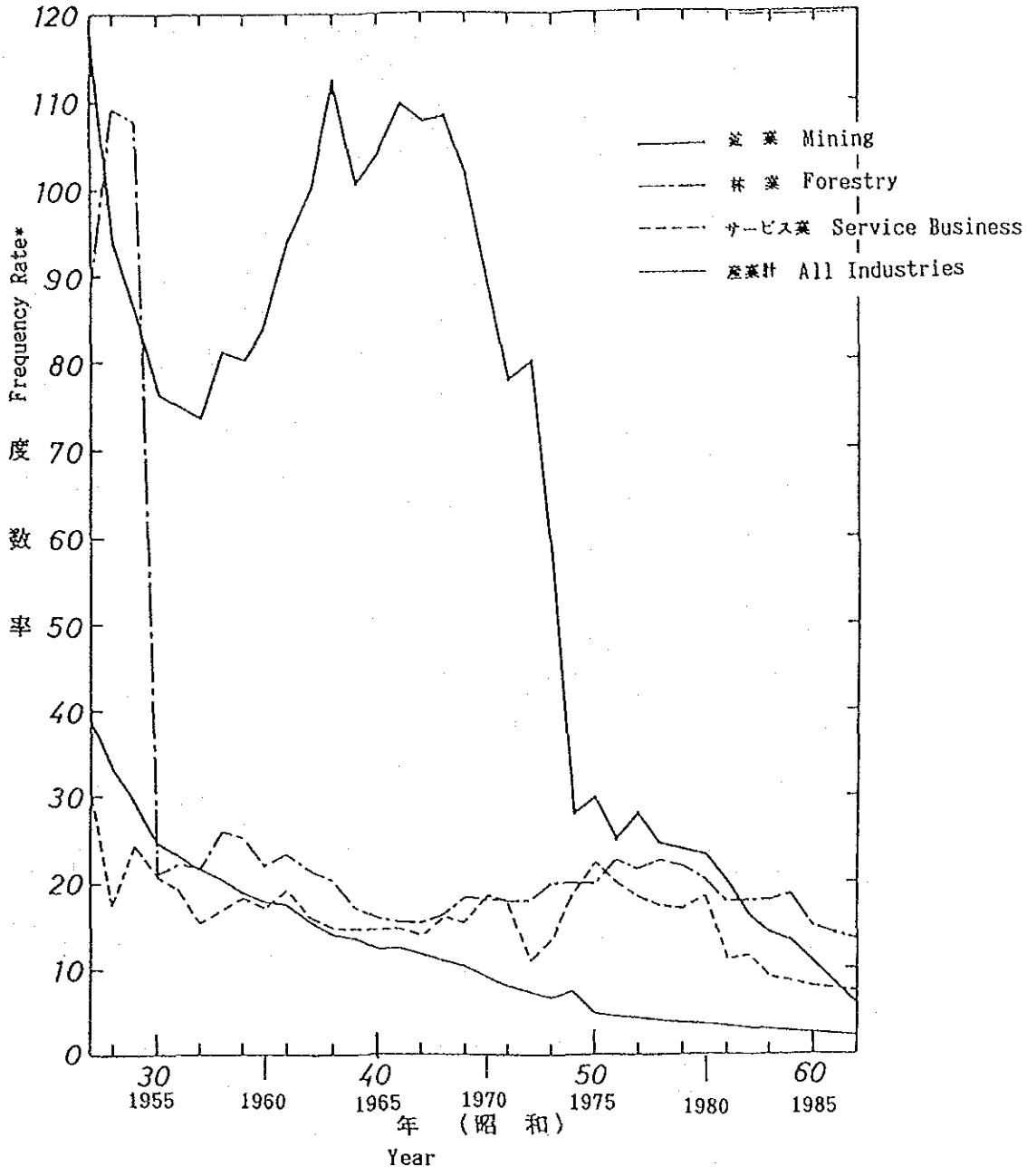

[A] OUTPUT OF COAL [x1000 ton]
[B] NUMBER OF FATALITIES
[C] NUMBER OF INJURED[x1000]
[D] NUMBER OF WORKERS
[E] FREQUENCY RATE OF ACCIDENTS PER A MILLION OF WORKERS
FREQUENCY RATE[E]
NUMBER OF WORKERS[D] x1000
OUTPUT[A], NUMBER OF FATALITIES[B], INJURED[C]x100
YEAR
1965
1970
1975
1980
1985
1990
[A]
[B]
[C]
[D]
[E]

Figure 2

Comparison of Mining Disaster Frequency Rate with Other Industries



$$\text{*Frequency Rate} = \frac{\text{Number of fatalities}}{\text{Total working time (hr)}} \times 1{,}000{,}000$$

Figure 3

Figure 4

History of the International Conference of Safety in Mines Research Institutes

Year	Conference	Location
1931	1st	Buxton, [UK]
1933	2nd	Montlucon, [France]
1935	3rd	Dortmund, [Germany]
1937	4th	Brussels and Paturages, [Belgium]
1948	5th	Pittsburgh, [USA]
1950	6th	Verneuli-en-Halatte, [France]
1952	7th	Buxton, [UK]
1954	8th	Dortmund-Dearne, [Germany]
1956	9th	Brussels and Heerlen, [Belgium]
1958	Restricted	Verneuli-en-Halatte, [France]
1960**	10th	Pittsburgh, [USA]
1961	Restricted	Warsaw, [Poland]
1963	11th	Aix-les-Bains, [France]
1965	Restricted	Sheffield, [UK]
1967	12th	Dortmund, [Germany]
1969	13th	Tokyo, [Japan]
1971	14th	Donetsk, [Ukraine, USSR]
1973	15th	Karlovy Vary, [Czechoslovakia]
1975	16th	Washington DC, [USA]
1977	17th	Varna, [Bulgaria]
1979	18th	Dubrovnik, [Yugoslavia]
1981	19th	Katowice, [Poland]
1983	20th	Sheffield, [UK]
1985	21th	Sydney, [Australia]
1987	22th	Beijing, [China]
1989	23th	Washington DC, [USA]
1991	24th	Donetsk, [Ukraine, USSR]
1993	25th	Johannesburg, [South Africa] (Scheduled)

(** : start of participation of Japan)

Tendency of Presented Papers at International Conference of Safety in Mines Research Institutes

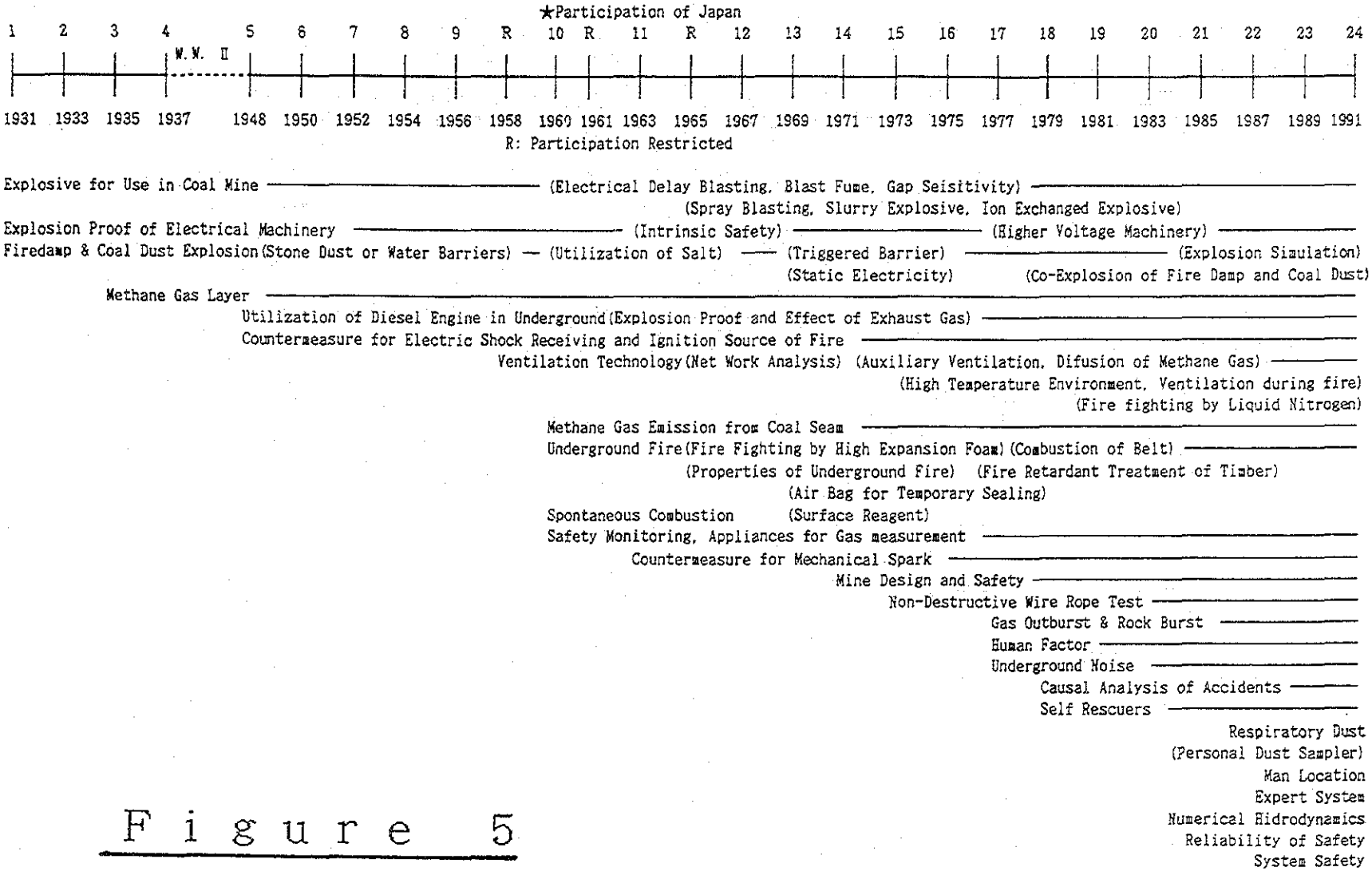


Figure 5

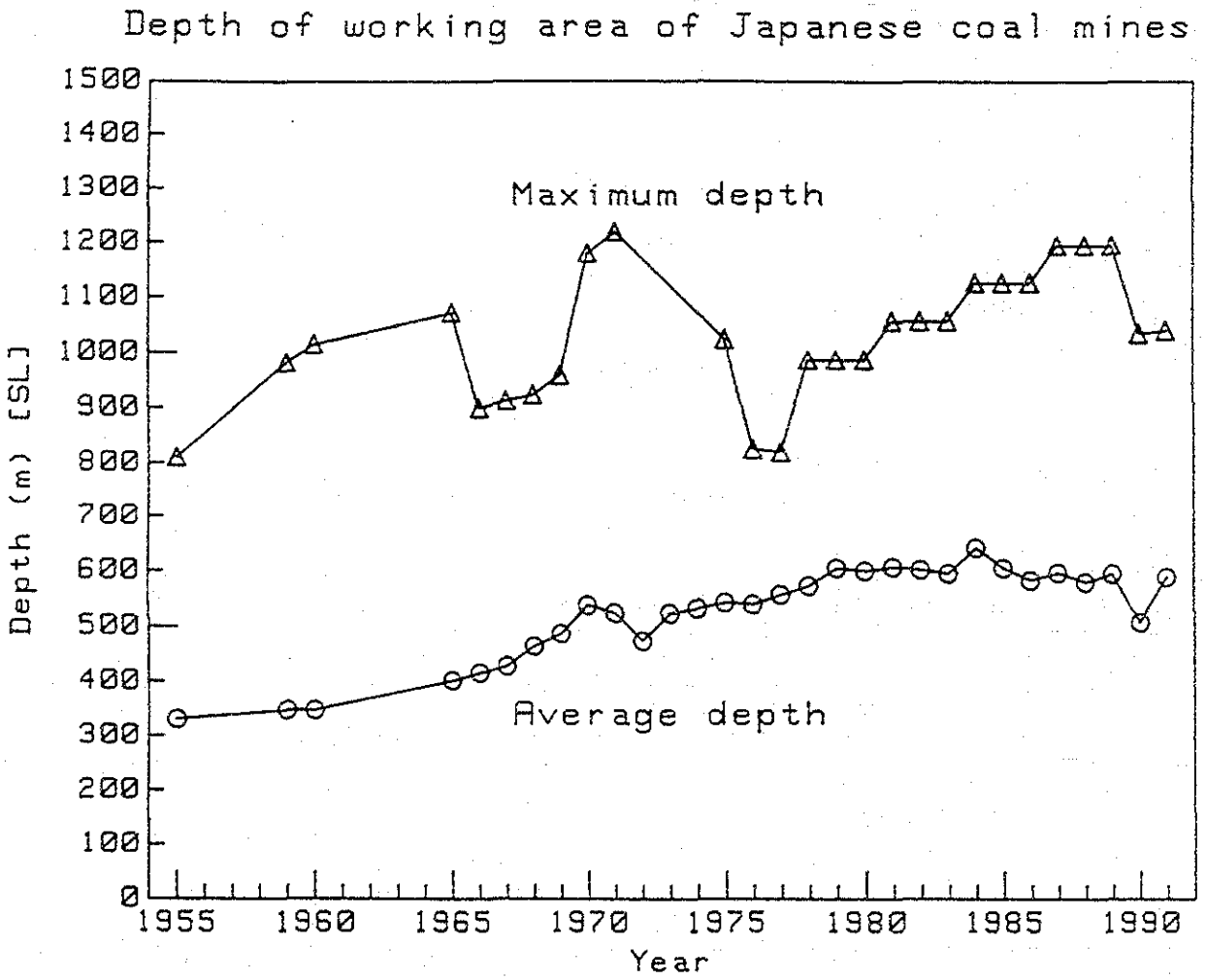

Depth of working area of Japanese coal mines
Depth (m) [SL]
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
Maximum depth
Average depth
1955
1960
1965
1970
1975
1980
1985
1990
Year

Figure 6

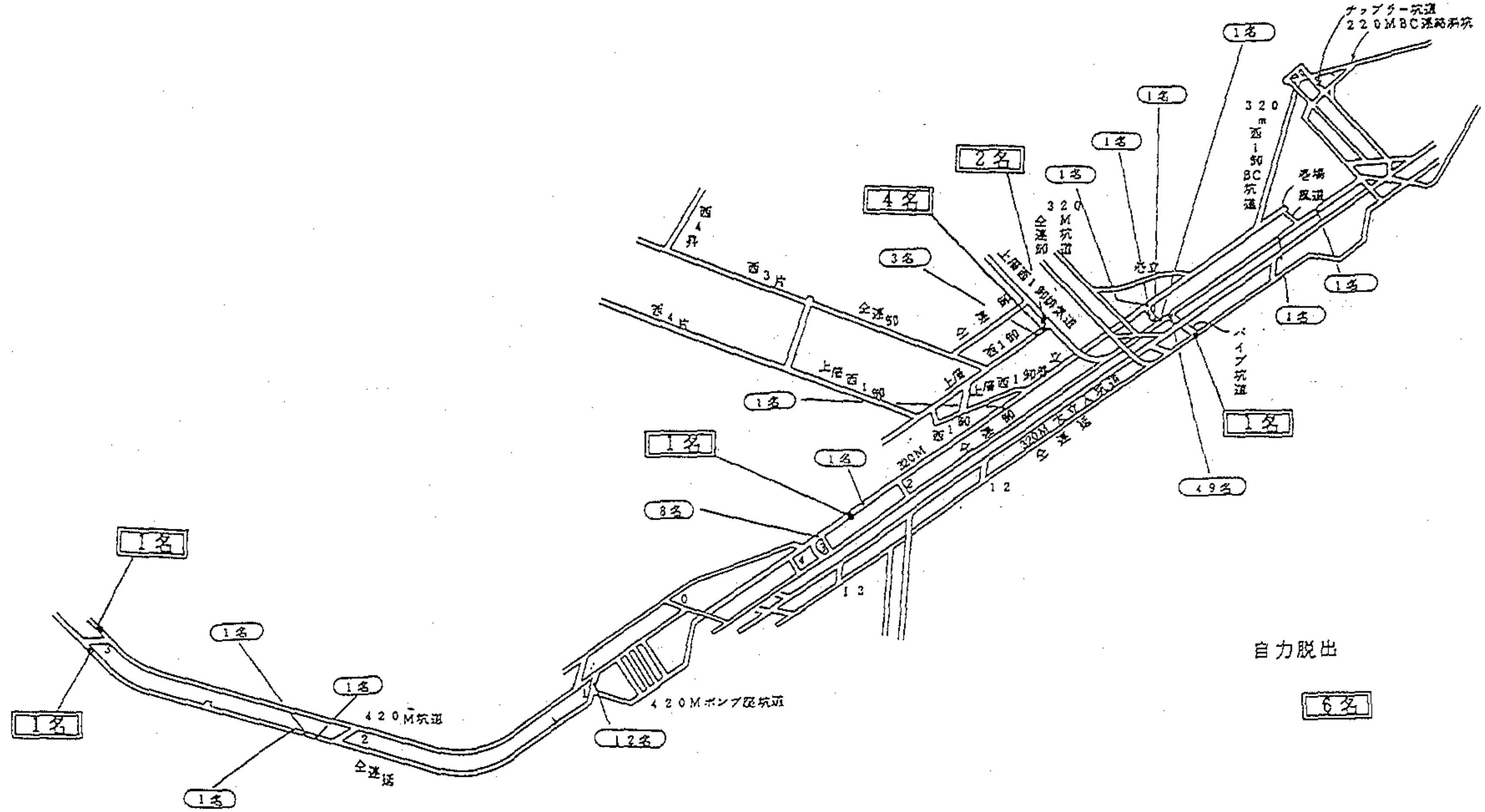
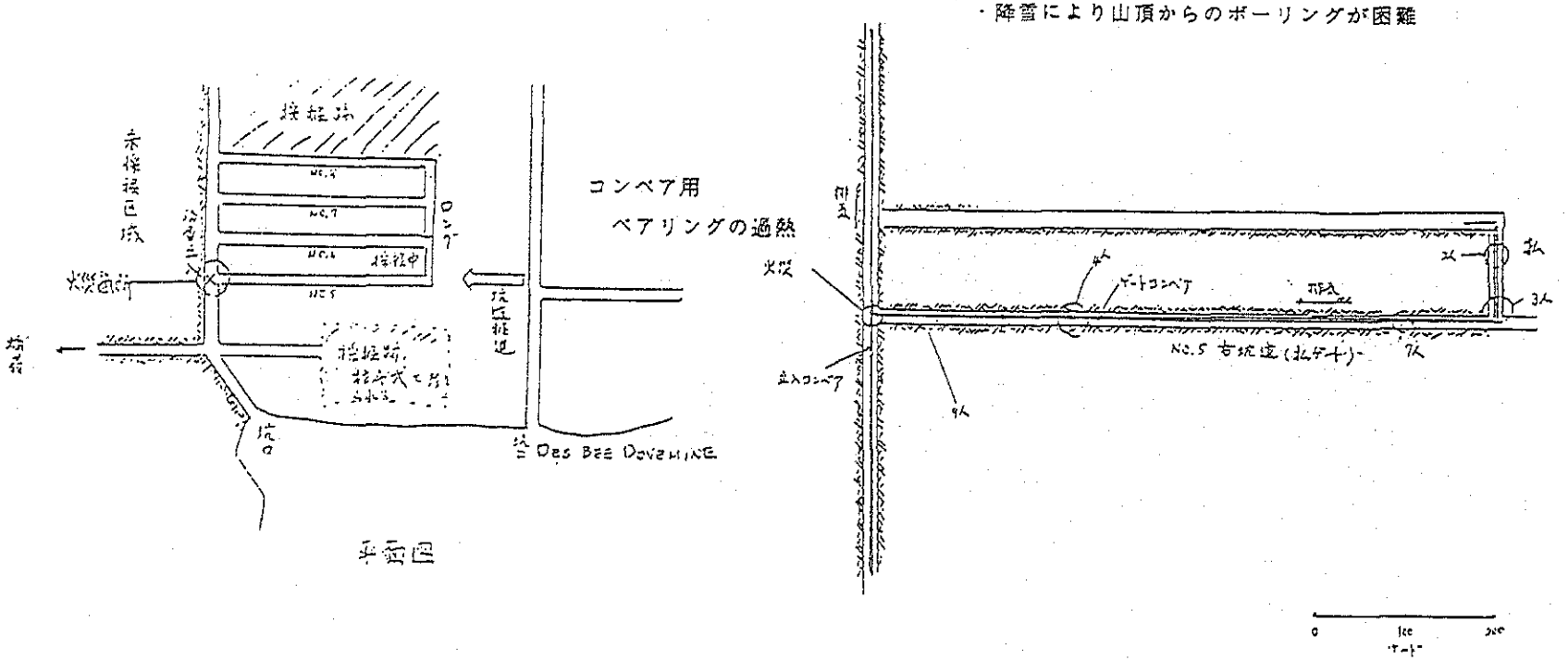


Figure 7

米国ユタ州" Ｗｉｌｂｅｒｇ炭鉱" の火災事故

発生日時： １９８４年１２月１９日
罹災者　： 死亡２７人（１名自力脱出）
事故調査委員会技術責任者： John C. English
Director of Education and Training,
Mine Safety and Health Administration(MSHA),
Department of Labour

・消火ホース消火器の不備
・水源の不足（坑内用水はポンプアップして使用）
・採掘残炭への延焼
・降雪により山頂からのボーリングが困難



平面図

Figure 8

ウクライナ Yuzhno－Donbass炭鉱 の火災事故

発生日時： １９９１年６月２９日
罹災者 ： 死亡３２人
事故調査委員会技術責任者： Dr.-Eng. Vladimir P. Kolosiuk
Deputy Director,
State Safety in Mines Research Institute

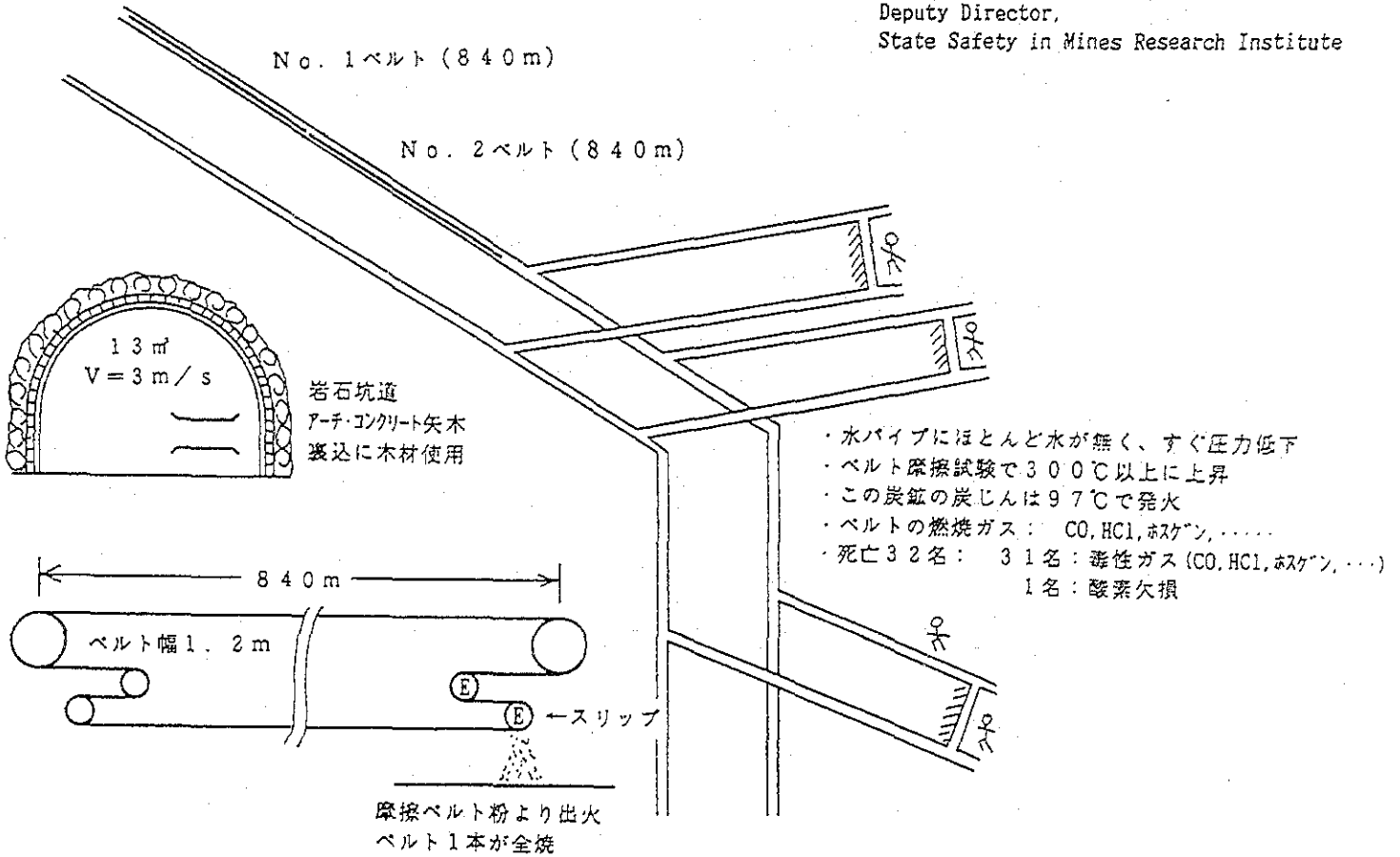


Figure 9

Serious Disaster* in Japanese Coal Mines since 1949** (I)

No	Block***	Date	Name of Colliery		Kind of Disaster	Death
1	Fukuoka	23 Jun '49	Shinyu	新入	Firedamp Explosion	11
2	Sapporo	6 Oct '49	Oowada	大和田	Underground open fire	14
3	Fukuoka	2 Dec '49	Tadakuma	忠隈	Roof fall	15
4	"	18 Dec '49	Uonuki	魚抜	Firedamp Explosion	13
5	Sapporo	27 Jan '50	Mojiri	茂尻	"	15
6	Ube	30 Oct '50	Wakaoki	若沖	Underground flooding	32
7	Fukuoka	7 Dec '50	Shikamachi	鹿町	Firedamp Explosion	21
8	"	3 Sep '51	Kamikaho	上嘉穂	Underground flooding	12
9	"	7 Sep '51	Ooshima	大島	Firedamp Explosion	14
10	"	20 Jun '52	Gotoji(Eda)	後藤寺江田	Underground open fire	10
11	"	2 Feb '54	Niihara	新原	Firedamp Explosion	15
12	"	20 Feb '54	Hisatsune-Shiki	久恒志枝	Underground flooding	36
13	Sapporo	31 Aug '54	Taiheiyo	太平洋	Firedamp Explosion	39
14	Fukuoka	18 Nov '54	Takeuchi-Uni	竹内字炭	"	12
15	"	16 Jun '55	Tagawa	田川	"	10
16	Sapporo	1 Nov '55	Mojiri	茂尻	"	60
17	Fukuoka	9 Nov '55	Akaike	赤池	Gas Outburst	11
18	"	14 Feb '56	Koyaki	香焼	Firedamp Explosion	12
19	Taira	7 Mar '56	Jyoban	常磐	Spontaneous Combustion	14
20	Sapporo	21 Jun '57	Tsutsumi	堤	Firedamp Explosion	10
21	Fukuoka	25 Nov '57	Higashinakatsuru	東中鶴	Underground flooding	18
22	"	7 May '58	Eguchi	江口	"	29
23	Sapporo	9 Jun '58	Mitsui-Sunagawa	三井砂川	Firedamp Explosion	10
24	Fukuoka	25 Sep '58	Onobori	大昇	"	14
25	Sapporo	21 Feb '59	Utashinai	歌志内	"	14
26	Fukuoka	21 Dec '59	Shinnyu	新入	"	23
27	Sapporo	1 Feb '60	Yubari	夕張	"	42
28	Fukuoka	30 Sep '60	Hoshu	豊州	Underground flooding	67
29	"	26 Sep '60	Momii	初井	Firedamp Explosion	13
30	Sapporo	30 Oct '60	Shoro	庶路	"	18
31	Fukuoka	9 Mar '61	Kamikiyo	上清	Underground Open Fire	71
32	"	16 Mar '61	Otsuji	大辻	"	23
33	Sapporo	30 Nov '61	Fukuzumi	福住	Firedamp Explosion	20
34	Ube	7 May '63	Ohama	大浜	Underground flooding	15
35	Fukuoka	9 Nov '63	Miike	三池	Coal Dust Explosion	458
36	"	13 Dec '63	Hoshi	坂	Firedamp Explosion	11
37	Sapporo	22 Feb '65	Yubari	夕張	"	62
38	Fukuoka	9 Apl '65	Iojima	伊王島	"	30
39	"	1 Jun '65	Yamano	山野	"	237
40	Sapporo	22 Mar '66	Kachi	奈知	"	12

Serious Disaster* in Japanese Coal Mines since 1949** (II)

No	Block***	Date	Name of Colliery		Kind of Disaster	Death
41	Sapporo	1 Nov '66	Honbetsu	本別	Firedamp Explosion	16
42	"	20 Jan '68	Bibai	美唄	"	16
43	"	12 May '68	"	"	Underground Open Fire	13
44	"	30 Jul '68	Heiwa	平和	"	31
45	"	2 Apl '69	Mojiri	茂尻	Firedamp Explosion	19
46	"	16 May '69	Utashinai	歌志内	Gas Outburst	17
47	Fukuoka	22 Sep '69	Shimoyamada	下山田	Firedamp Explosion	14
48	Sapporo	15 Dec '70	Mitsui-Sunagawa	三井砂川	"	19
49	"	17 Jul '71	Utashinai	歌志内	Gas Outburst	30
50	"	2 Nov '72	Ishikari	石狩	Firedamp Explosion	31
51	"	19 Dec '74	Mitsui-Sunagawa	三井砂川	"	15
52	"	27 Nov '75	Horonai	幌内	"	24
53	"	11 May '77	Mitsui-Ashibetsu	三井芦別	"	25
54	"	16 May '79	Minami-Oyubari	南大夕張	"	11
55	"	16 Oct '81	Yubari-Shinko	夕張新坑	Gas Outburst	83
56	"	"	"	"	Firedamp Explosion	10
57	Fukuoka	18 Jan '84	Miike	三池	Underground Open Fire	83
58	"	24 Apl '85	Takashima	高島	Firedamp Explosion	11
59	Sapporo	17 May '85	Minami-Oyubari	南大夕張	"	62

* Serious disaster: Disaster which claims more than ten people's death.

** The Japanese Mine Safety Law have been enforced in August 1949.

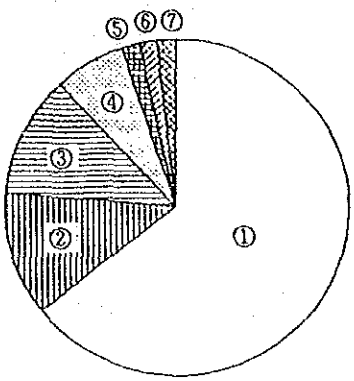
*** Block: Administrative area by the Local Mining Inspection Bureau.

Figure 10

Serious Disaster in Japanese Coal Mines(since 1949)
炭鉱に於ける重大災害（昭和２４年以降）

件数別内訳 Items of disaster

単位　件

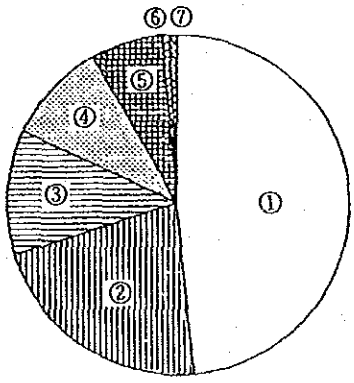


①	ガス爆発	38	(64.3%)	①Firedamp explosion
②	坑内火災	7	(11.9%)	②Underground open fire
③	坑内出水	7	(11.9%)	③Underground flooding
④	ガス突出	4	(6.8%)	④Gas outburst
⑤	自然発火	1	(1.7%)	⑤Spontaneous combustion
⑥	落盤	1	(1.7%)	⑥Roof fall
⑦	炭じん爆発	1	(1.7%)	⑦Coal dust explosion

Serious Disaster in Japanese Coal Mines(since 1949)
炭鉱における重大災害（昭和２４年以降）

死者数別内訳 Number of killed persones

単位　人

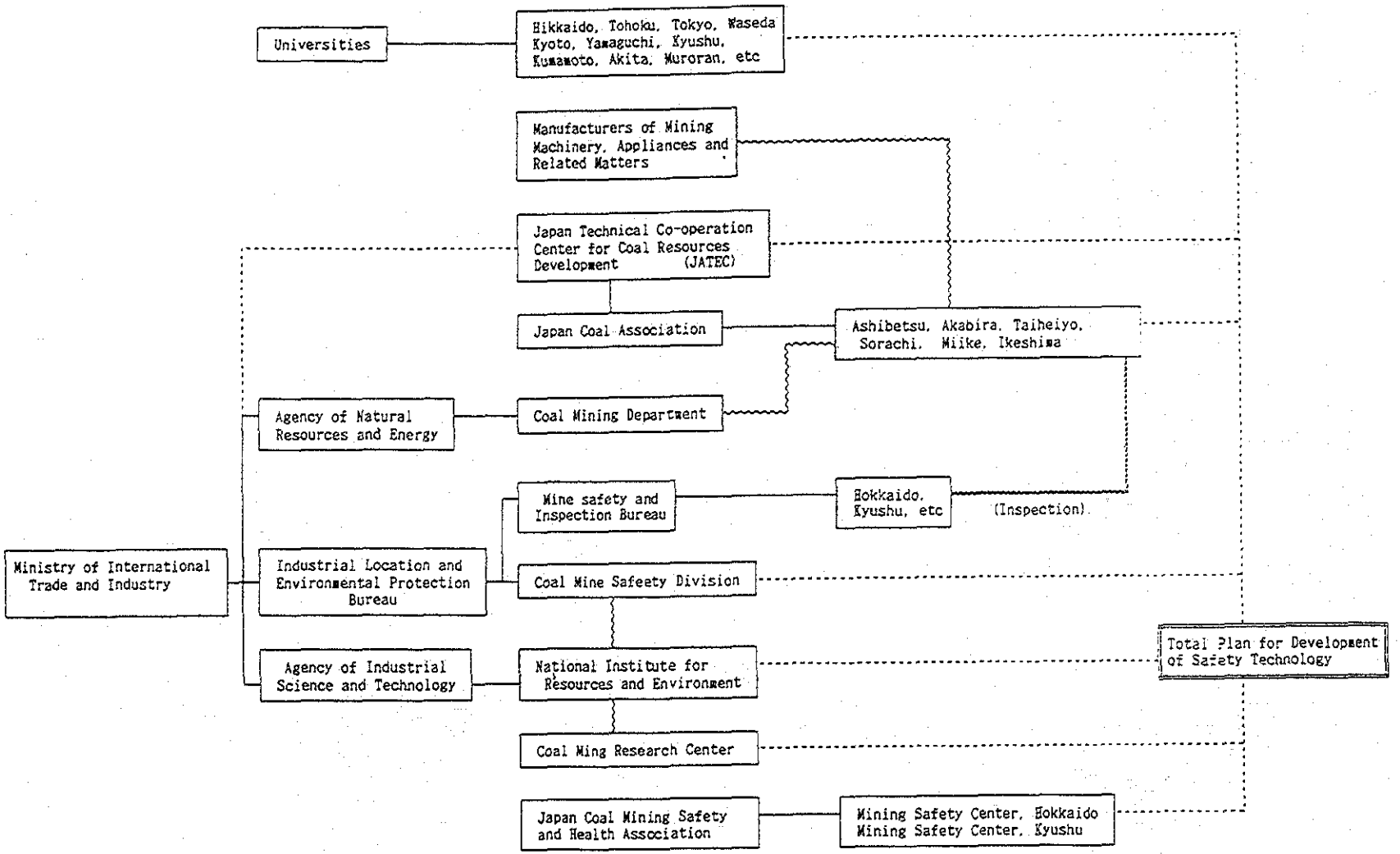


①	ガス爆発	1011	(48.3%)	①Firedamp explosion
②	炭じん爆発	458	(21.9%)	②Coal dust explosion
③	坑内火災	245	(11.7%)	③Underground open fire
④	坑内出水	209	(10.0%)	④Underground flooding
⑤	ガス突出	141	(6.7%)	⑤Gas outburst
⑥	落盤	15	(0.7%)	⑥Roof fall
⑦	自然発火	14	(0.7%)	⑦Spontaneous combustion

Figure 11

Organizations for Safety Achievements in Japanese Coal Industries

Figure 12



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JICA

平成4年9月