Summary

Report on the Nagoya Works power failure accidents

-- The causes and preventive measures --

November 25, 2014
Nippon Steel & Sumitomo Metal Corporation

This is a summary of the full version of “Nagoya Works Power Failures Accident Measures Report”. For details, refer to the corresponding pages of the full version of the Report. http://www.nssmc.com/common/secure/news/20141125_200_03.pdf

NIPPON STEEL & SUMITOMO METAL CORPORATION

1. Introduction

We sincerely regret the great trouble and inconvenience caused to the local residents and those concerned.

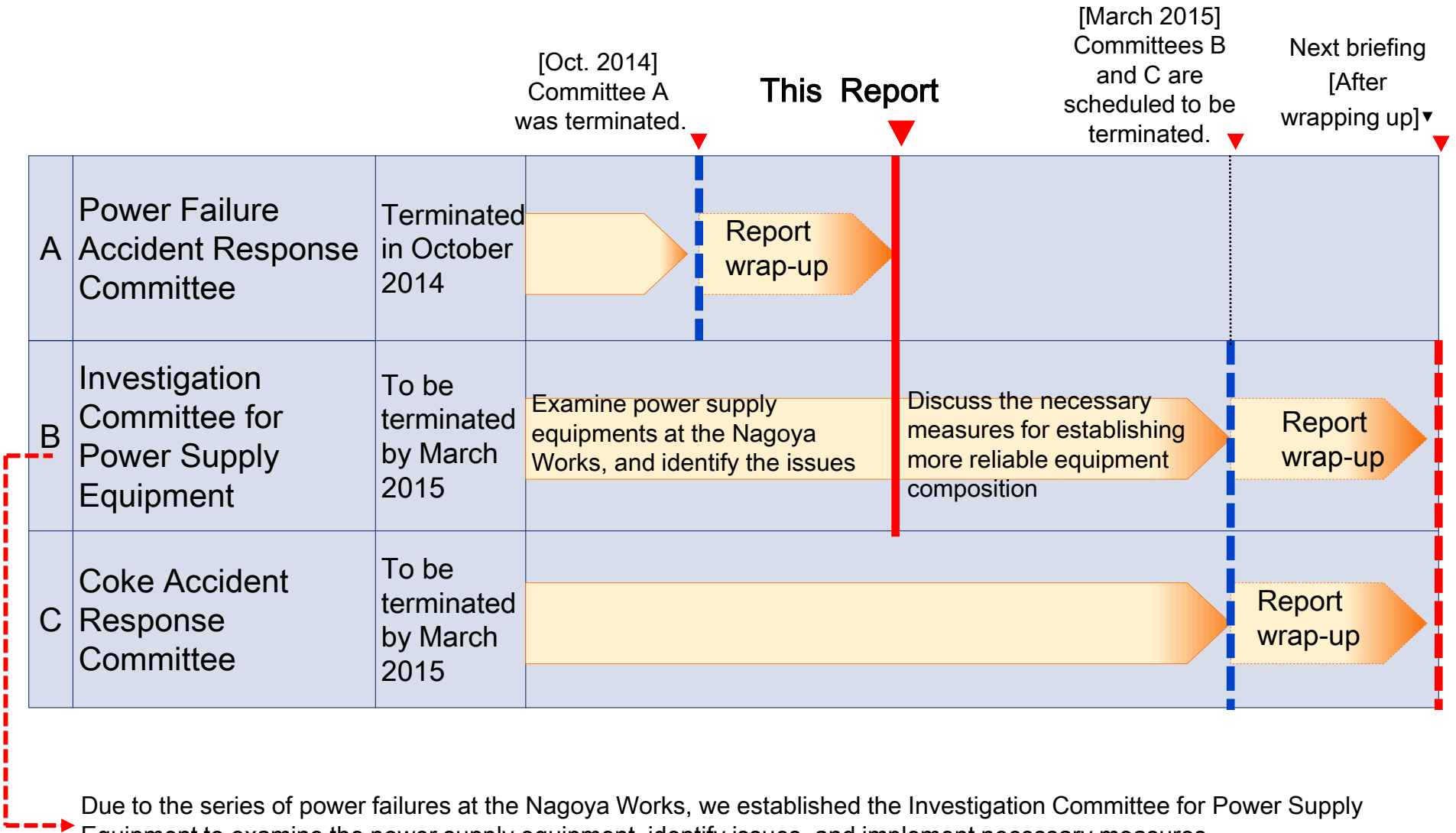
After the accidents, Nippon Steel & Sumitomo Metal Corporation (“NSSMC”) immediately established the Power Failure Accident Response Committee, including outside experts from academia and industry, and investigated the events. We have determined the causes and identified measures that we believe can prevent recurrence. These results of our investigation and analysis are summarized from the next slide.

On September 3, 2014, while we were determining the causes and identifying preventive measures of those power failures, a coke oven fire occurred at Nagoya Works.

While the new accident is still under investigation by the local authorities and the causes remain to be determined, NSSMC has voluntarily established the Coke Accident Response Committee, chaired by an outside expert, and is exerting a strong effort, independently of the authorities, to determine its causes and study preventive measures.

We will hold a briefing regarding this accident, which occurred in September, at the earliest possible opportunity. We appreciate your understanding and patience.

2. Related committees and reporting schedule

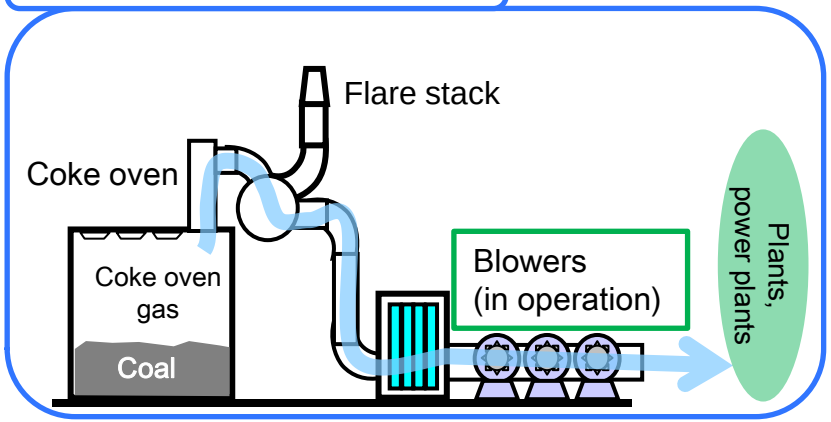


Due to the series of power failures at the Nagoya Works, we established the Investigation Committee for Power Supply Equipment to examine the power supply equipment, identify issues, and implement necessary measures.

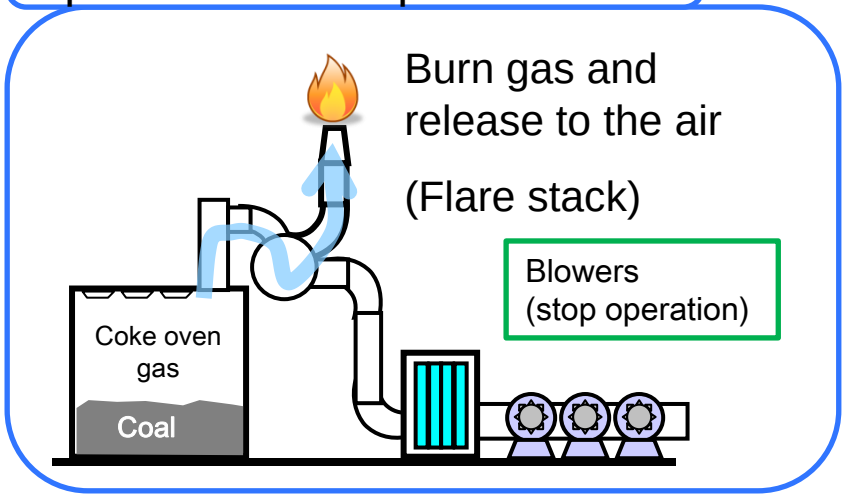
I. The Causes and Preventive Measures

1. The cause of smoke accompanying the power failures

Ordinary operation



When gas blowers stop operation due to power failure



Steel is made of iron and coal. The coal is heated in a coke oven before being used in steelmaking.

Coke oven gas generated during the coal-heating process is transported via a pipeline to a power plants or other plants within the premises as a fuel source.

Electric blowers are used to transport the coke oven gas to the power plants and other plants, but they will stop functioning if there is a power failure.

Even when a power failure occurs, gas generation from the coke oven will continue for a while. There would be a huge accumulation of coke gas, which has to be released to the air.

The gas is burned off in the flare stack above the coke oven.

If the gas is not completely burned off, it turns into smoke including soot.

2 - (1) Analysis of four power failures, and measures taken

(1) January 17, 2014

- Due **to tripping of an air circuit breaker** of a power plant within the premises, power supply to coke oven gas blowers stopped. This resulted in accumulation of gas which was burned off and the combustion product was released to the air. At that time, smoke was generated.

The cause of breaker tripping	➡	Moisture had entered the breaker.
Why moisture was present	➡	The circuit breaker's air, needed for the breaker to operate properly, was not sufficiently dehumidified.

Actions

1. Inspected all the breakers in which moisture could be mixed. [Done by Aug. 26, 2014]
   Change the breakers to a different model. [By the end of March 2015]

2. Improved the dehumidification of air in the vicinity of the breakers. [Done by Jan. 31, 2014]

2 - (2) Analysis of four power failures, and measures taken

(2) January 20, 2014

- During the work for resumption of operation of equipment after the power failure of Jan. 17, transformers stopped operation due to an overload. This then led to disruption of power supply to the coke oven gas blowers, and accumulation of gas. The gas was burned off and the combustion product was released to the air. At that time, smoke was generated.

Cause of the overload

➡ Transformers were monitored not using the current set-point but by other less-accurate methods. One transformer's maximum current set-point was set at a lower level than that of other transformers.

Actions

1. Revised the manual to specify direct monitoring of the current set-points.
   [Done by Feb. 17, 2014]

2. All transformers' maximum current set-points were set at the same value.
   [Done by Apr. 24, 2014]

2 – (3) Analysis of four power failures, and measures taken

(3) June 22, 2014

- Power supply from Chubu Electric Power was accidentally blocked during construction work. Then, the entire Nagoya Works' power supply became dependent on four in-house power generators. However, an automatic power stabilization controller of the generators did not work properly and the generator operation was stopped. Loss of power supply from both Chubu Electric Power and in-house generators caused coke oven gas blowers to stop working. Due to the accident, accumulated gas was burned off and the combustion product released to the air. At that time, smoke was generated.

Why the power from Chubu Electric Power was blocked	➡ Improper function and treatment to prevent accidental shutdown
The cause of the automatic stabilization controller's malfunction	➡ Some flaws in the program prepared by a supplier

Actions

1. Issued an Alert ("Error-caused shutdown") and reviewed the operation status. [Done immediately]
2. Make the supplier revise the program. [By the end of June 2015]

2 – (4) Analysis of four power failures, and measures taken

(4) July 27, 2014

- An in-house power generator cable was overheated and part of the generator was melted, leading to a power short. This resulted in power outage in part of the steelworks and eventually power supply to the coke oven gas blowers was stopped. The accumulated gas that resulted was burned off and the combustion product released to the air. At that time, smoke was generated.

The cause of overheating ➡ The end of a cable came into contact with metal components of the generator resulting in a short.

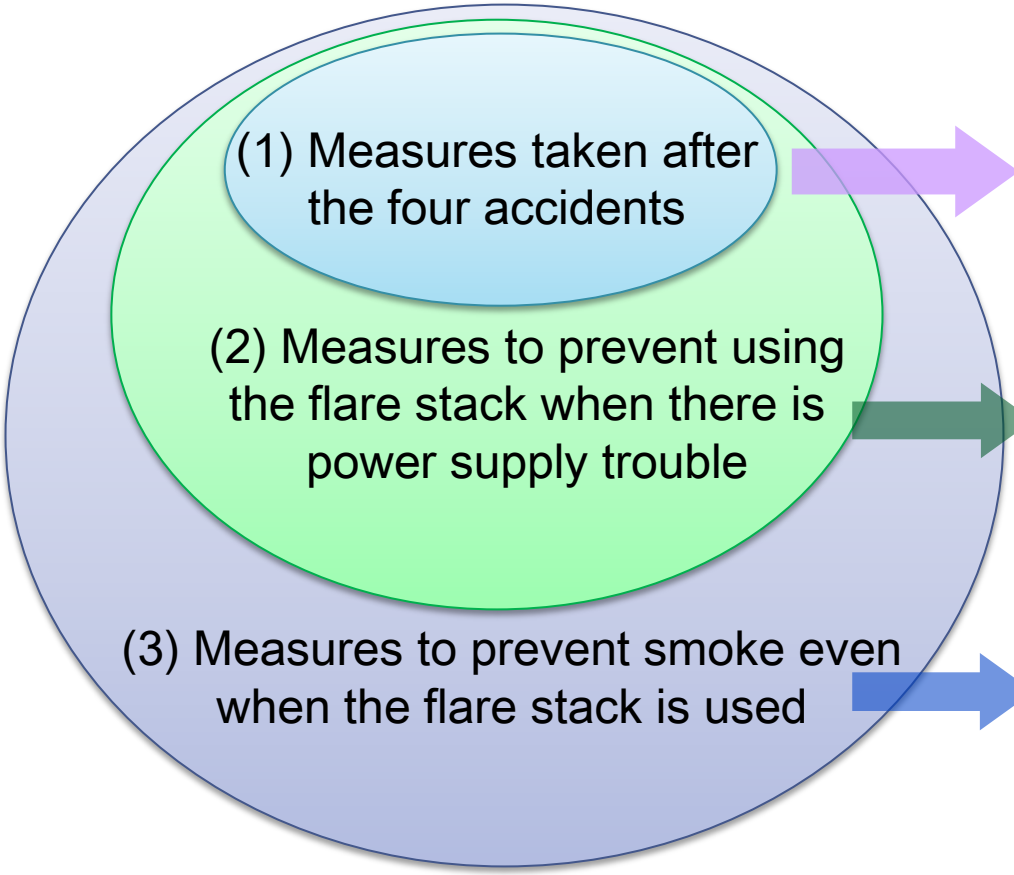
Actions

1. Improved management of tools and components in the vicinity of the ends of cables.
   [Standardized by Aug. 25, 2014]

2. Took steps to prevent improper or accidental contact of cable ends with equipment.
   [Done by Sep. 27, 2014]

3 – (1) Major measures to prevent similar accidents

As quickly as possible, we will complete implementation of three sets of measures to prevent generation of smoke.



(1) Mostly completed
(as stated above)

(2) Now being implemented (See p. 10)

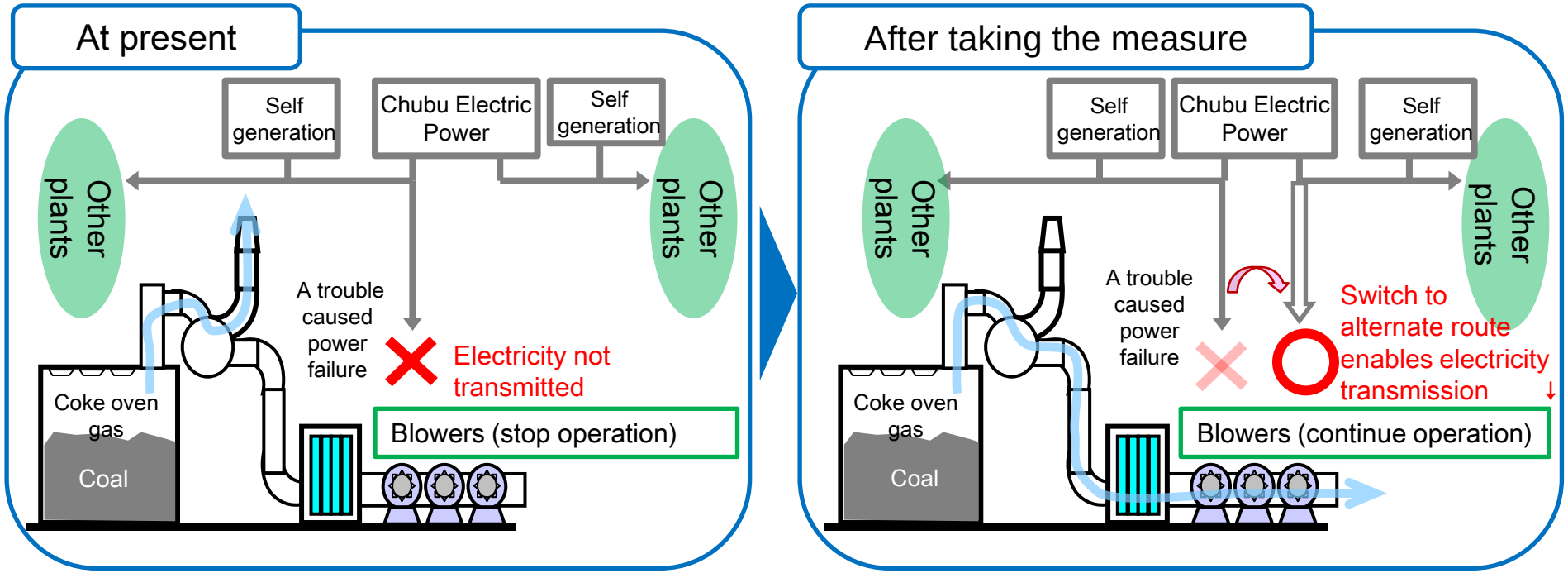
(3) Now being implemented
(See p. 11 and 12)

3 – (2) Measures to prevent using the flare stack, when there is power supply trouble

【Measure】 Establish an alternate electric supply route

[To be completed by June 2015]

If trouble makes the standard route unusable, switching to the alternate route will allow electric supply to the coke oven gas blowers to continue.



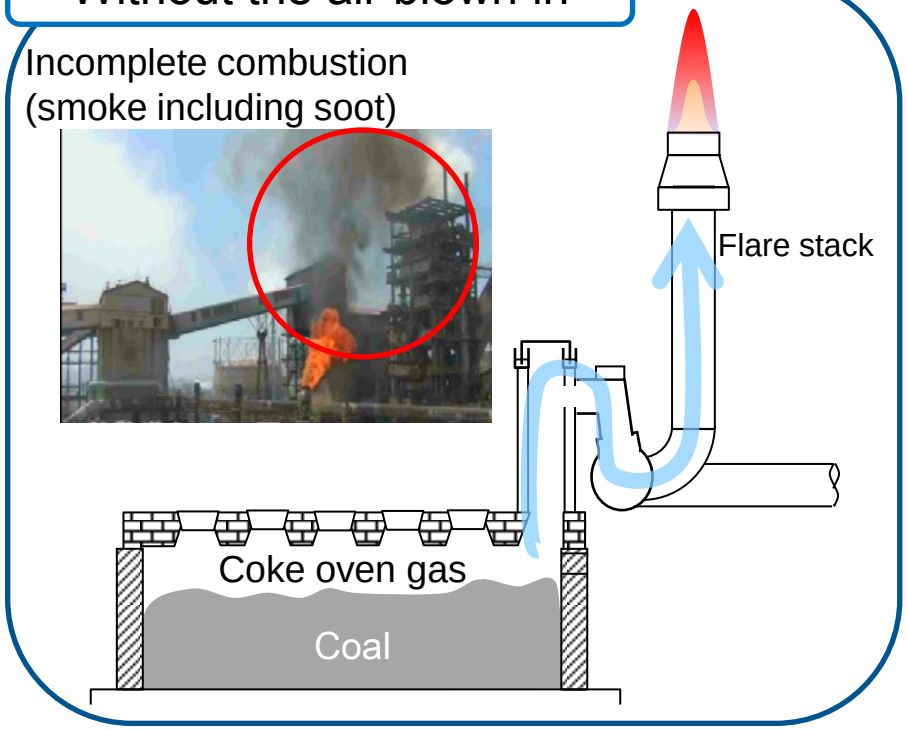
3 – (3) Measure to prevent smoke even when the flare stack is used

【At present】 Mechanism to promote complete burning by blowing in massive air

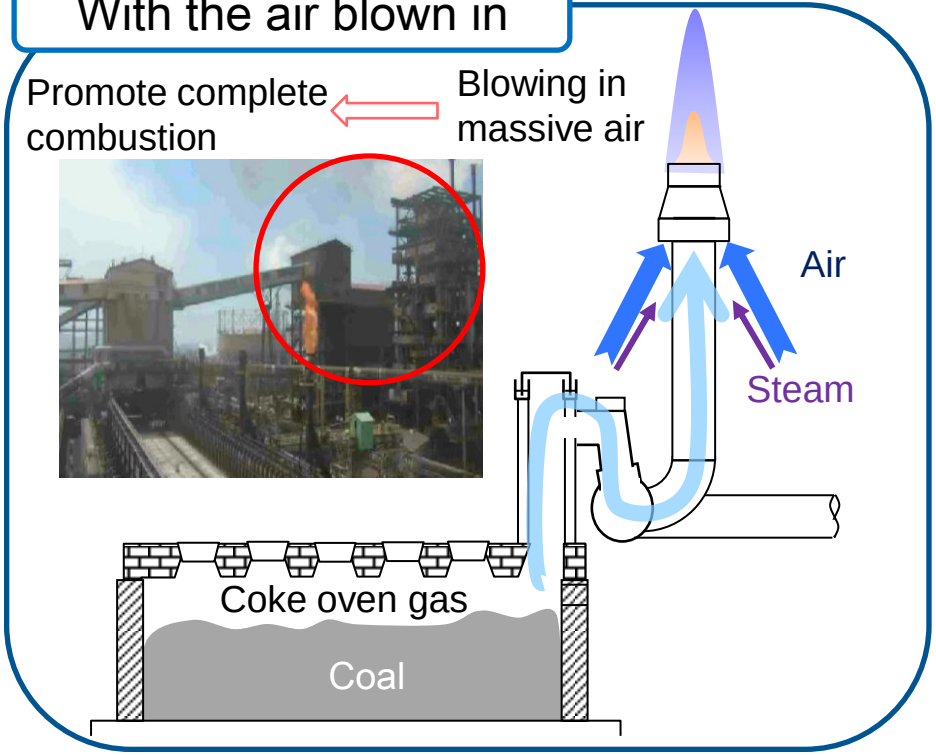
By blowing in a massive amount of the air, complete burning of the gas is promoted and smoke generation is significantly reduced. The air needs to be blown into the flare stack with the steam* but when power failure occurred, the steam supply was halted, resulting in incomplete combustion.

* The steam also helps lower the temperature of the burned and released gas.

Without the air blown in



With the air blown in



3 – (4) Measure to prevent smoke even when the flare stack is used

【Measure】Ensure steam supply to the flare stack even when a power failure occurs

Even in case of a power failure, both steam and massive air are to be supplied to the flare stack.

Blow in air and steam to facilitate combustion

Steam supply

Small boilers and an emergency power generator
(To enable steam supply in case of a power failure)

[Installed by Nov. 2014]

Steam tank
(Store steam on regular basis in preparation of immediate needs for steam in case of emergency)

[To be constructed by May 2015]

[42 small boilers]

One unit

Power supply

[Emergency power generator]

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II. Measures to resolve the underlying issues

1. Underlying issues

Each power failure had its own distinct cause. However, the Power Failure Accident Response Committee (including outside experts) pointed out that, given the fact that they occurred within six months and could not have been prevented, the following underlying issues may exist.

Possible underlying issues

- Low risk sensitivity to changes in equipment and operation
- Low sensitivity to work-related risks
- Need for more knowledge and forethought when new or renovated equipment is to be adopted
- Need for employee training and standardization of operation procedures in case of adoption of new or renovated equipment
- Communication issues

Direction of measures

1) Enhance risk management function of the Energy Department
2) Enhance the skill of technical staff and support for them at worksites
3) Improve management capability of on-site managers
4) Promote establishing documents on standardization as a basis of operation
5) Improve educational and training programs
   (To predict the risk in not normal operation, etc.)

2 – (1) Measures to resolve the underlying issues

We are implementing measures to resolve the underlying issues substantively and fundamentally from a long-term perspective.

(1) Organizational change

Three divisions and one department for safety, power supply management, etc. were established to integrate corporate-wide capabilities and resolve the issues.

[Implemented Nov. 1, 2014]

- The Plant Safety Division was organized to enhance corporate-wide risk management to prevent accidents and reduce damage.
- The Energy Technical Division was established in the head office to centralize corporate-wide enhancement in energy technological capability and augment human resources. The Nagoya Works established the Energy Division specialized in operation and maintenance related to utilities (power supply management, etc.)
- The Monozukuri (manufacturing capabilities) Planning Department was established to promote corporate-wide revision of operation procedure manuals and re-examination of operation procedures.

* The above organizational changes respond mainly to “Direction of measures” 1), 2), and 4) on p. 14.

2 – (2) Measures to resolve the underlying issues

(2) Risk management and employee training

We are establishing arrangements to prevent accidents and are re-examining the educational and training programs. [Now being implemented]

○ Risks are to be managed at various management levels (works, division, department, and plant levels) depending on the impact of foreseeable events.

○ Various measures to enhance capabilities of on-site managers are being implemented.

- Establish checklists to prevent trouble and put them to use.
- Revise the emergency action standards, and conduct drills.

○ Enhance equipment engineering capability of technical staff

- An engineering manual containing examples of past failures was newly prepared and the educational programs for technical staff in all technical departments are being conducted.

* The above measures respond mainly to “Direction of measures” 3) and 5) on p. 14.

3. Nagoya Works' comprehensive checking of equipment

Due to the power failures, the Nagoya Works conducted comprehensive checking of all the equipment and identified potential risks which may cause environmental problems and disasters.

○ The examination and updating of the status of equipment (approx. 2,000 in number) and the soundness of environmental and disaster prevention devices (approx. 400) were completed. Some areas for improvement were found. The measures which required immediate action have been taken.

○ The emergency standard procedures and their training programs (approx. 500) were checked. Matters to be improved were identified and measures will be taken by the end of the current fiscal year (March 2015). The measures which required immediate action (i.e., drill for response when the regular electric route is bypassed; standardized initial response when an environmental accident occurs.) have been taken.

◇ The Investigation Committee for Power Supply Equipment is inspecting the equipment, identifying the issues, and discussing the necessary measures for establishing more reliable equipment composition.

4 – (1) Information, briefings, and committees

(1) We have reviewed the reporting methods so that we could better communicate with the city governments to inform all concerned in the relevant communities as quickly as possible in case of an emergency.

- We have provided names and contact information of key NSSMC persons to Tokai City and Chita City and obtained corresponding information from both governments. [Done in Feb. 2014]

- We participated in a drill conducted by the Safety Office of Tokai City and confirmed how to communicate information. [Done in March 2014]

(2) As a part of our three sets of measures, we are considering conducting a drill on how to operate equipment in case of power failure. On such an occasion, we will provide information in advance, to the city governments.

4 – (2) Briefing for the benefit of local residents

The briefings are for representatives from all community associations and neighborhood associations (approx. 120) in all of Tokai City and a part of Chita City.

- ○ Assuming participation of one or two persons from each association, about 200 participants in total are expected.
- ○ The first briefing is scheduled to be open to the media.

◆ Briefing schedule

1) Tokai City Shoko Center	Nov. 26 (Wed.) from 18:30	《Open to the media》
2) Tokai City Bunka Center	Nov. 27 (Thu.) from 18:30	
3) Tokai City Shiawase Mura	Nov. 28 (Fri.) from 18:30	
4) Chita City Seishonen Kaikan	Dec. 2 (Tue.) from 18:30	

The briefing documents will be widely circulated to people in the communities through their representatives who participate in the briefings.

4 – (3) Details of related committees

Power Failure Accident Response Committee

[Held: Sep. 16, 25, Oct. 16, 27, 2014 (four times)]

- Established: June 22, 2014
- Members

Chair: Shinji Fujino, Managing Director and Member of the Board
Outside experts: 4 in total
Akihiko Yokoyama: Professor; Department of Advanced Energy, Graduate School of Frontier Sciences, The University of Tokyo
Three engineers from heavy-industry makers who have experience and expertise in power-receiving and distributing equipment and its management.
Other committee members from NSSMC: 13 in total

Investigation Committee for Power-Receiving and Distributing Equipment

[Held: Sep. 16, 25, Oct. 16, 27, 2014 (four times) continuing to be the end of Mar. 2015]

- Established: Aug 11, 2014
- Members

Chair: Kazuyuki Orita, Executive Officer
Outside experts: 4 in total
Akihiko Yokoyama: Professor; Department of Advanced Energy, Graduate School of Frontier Sciences, The University of Tokyo
Three engineers from heavy-industry makers who have experience and expertise in power-receiving and distributing equipment and its management.
Other committee members from NSSMC: 18 in total.

4 – (4) Details of related committees

Coke Accident Response Committee

[Held: Oct. 11, 23, Nov. 24 2014 (three times) continuing to be the end of Mar. 2015]

- Established: Sep. 4, 2014
- Members

  Chair: Isao Mochida, Professor Emeritus, Kyushu University

  Outside experts: 3 in total

  Ritsu Dobashi, Professor, The University of Tokyo Graduate School of Engineering, Department of Chemical System Engineering

  Takayuki Takarada, Professor, Gunma University, Graduate School of Engineering, Division of Environment Management

  Hisao Makino, Director, Central Research Institute of Electric Power Industry

  Other committee members from NSSMC: 3 in total
  (from Nov. 2014 after change in members; only 2 members up to the end of Oct.)

A message from NSSMC

We at NSSMC sincerely regret the occurrence of the accidents, are making utmost concerted efforts to prevent further accidents, and hope to regain the trust of people in the communities and others concerned.

We are determined to realize our management principles that emphasize the importance of integrity and reliability in our actions, and to contribute to communities and society through steelmaking.

We appreciate your understanding and support.

Contact information

For inquiries:

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