Nippon Steel's Green Transformation (GX) Initiatives

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Summary of Q&A[1]

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◆ Carbon Neutral Technology Development

Q Please tell us about the technical issues and the progress you have made toward resolving them for each of large-scale electric arc furnaces (EAFs), shaft furnaces, and hydrogen reduction blast furnaces (BFs).

A With regard to large-scale EAFs, an increase in furnace size will solve the issue of productivity. However, since the EAFs have a central-heating structure, the heating region does not expand proportionally even when the furnace is enlarged, making it difficult to achieve temperature uniformity in the furnace, as well as to control the composition. In this regard, we have repeated verification at the existing EAF in Hirohata and the testing furnace in Hasaki, and we have confirmed that consistent uniform quality can be achieved by combining various technologies such as stirring, blowing, and refining. As we have obtained confirmation that a consistent quality can be maintained even with a larger furnace, we have reached a decision to proceed with commercial implementation.

In the case of shaft furnaces, there is an issue of sticking and powdering, driven by the temperature distribution as the raw material falls from top to bottom. We are therefore making development efforts focused on establishing an optimal temperature pattern in the furnace for smooth material descent and proper reduction.

Regarding hydrogen reduction in BFs, we have accumulated expertise in the handling and heating of hydrogen in pilot-scale BFs. In full-scale BFs, there is a limit to the range of hydrogen injection possible through tuyeres, with issues of gas distribution in the furnace becoming apparent. However, having carried out analysis using simulations and mathematical models, we have reached a level where we can predict furnace behavior even in large BFs, and have obtained a positive outlook for the reproduction of these results in actual commercial furnaces.

Q After the implementation of GTCC, can you seamlessly convert fuels from LNG to

[1] Based on information as of the date of the briefing unless specified otherwise.

hydrogen and ammonia? Does the site plan allow for supply of hydrogen and ammonia?

A Although we do not develop power generation technologies ourselves, by exchanging information with equipment manufacturers and electric power companies, we are conducting studies based on technological trends related to hydrogen co-firing and ammonia co-firing. We have gained the understanding that, although the combustor needs to be replaced, fuel conversion of the facility as a whole will be possible after the implementation of GTCC. Regarding the site plan of the steelworks, we are working with electric power companies, including joint thermal power companies, on a comprehensive study including necessary supply scales, prerequisites, and infrastructure such as port development, based on potential demand at each industrial complex. That said, cost-related challenges for both hydrogen and ammonia are significant, and we are not at a point where we can clarify the timing of the implementation at this time.

◆ Overseas trends

Q Please explain the carbon neutrality initiatives of U. S. Steel and AM/NS India.

A U. S. Steel has set a target of reducing greenhouse gas (GHG) emissions by 20% over 2018 levels by 2030. In addition to process optimizations such as energy-saving measures to reduce coal and coke input, U. S. Steel is promoting the use of renewable energy and decarbonized power sources, and is reducing emissions based on a plan that includes the incorporation of facilities with large-scale EAF production capacity (Big River Steel).

AM/NS India has been working to reduce emissions by expanding the introduction of renewable energy and increasing the percentage of scrap used (from around 3-5% at present to the target of 10% by 2030) in line with the Indian government's emission intensity targets.

◆ Policy Design of GX Steel

Q Don’t you need to disclose information on the details and calculation methods of Gx Steel-related CO_2 reduction projects? In addition, how long will reduction amounts be recorded and settled after the implementation of the reduction project?

A For GX steel, the guidelines formulated by the Japan Iron and Steel Federation (JISF) stipulate that information such as the reduction project’s individual name, location for implementation, reduction technology method (e.g., conversion from BFs to EAFs), calculation period and achieved amount of reduction, and compliance with strict conditions regarding additionality of reductions will be compiled and disclosed on corporate websites.

With regard to the allocation of achieved reductions, the JISF’s guidelines state that it is

desirable for the allocation to expire within three years after the end of the calculation period, and we plan to make the allocation within this framework.

Q What is the difference between the mass balance method and the allocation method?

A While the mass balance method allocates the achieved reduction amount, the allocation method allocates the amount of emissions, and we recognize that the suitability of the allocation method is more easily recognized as appropriate from the viewpoint of consistency with ISO 14067 and ease of explanation.

◆ Investment, Raw Materials and Business Strategy

Q The CAPEX slide of the briefing materials is the same as that of the previous year. Does this mean there are no particular changes?

A Our forecast is unchanged from last year, with a peak in EAF-related investment around 2030, the subsequent completion in development of hydrogen reduction technology, and then a peak in hydrogen-related investment around 2040. Currently, development is progressing smoothly, and there have been no major changes since last year.

Q Your investment timeline estimates appear to suggest that after the EAF conversion, you will only focus on technology development up to the completion of hydrogen reduction technology in the 2030s. Won't you also need to make efforts on reducing emissions during this interim period?

A After conversion to EAFs, large-scale emission reductions will occur after 2040, when the hydrogen infrastructure is ready. However, considering future uncertainties, some technologies are emerging that enable reduced emissions, even if only on a smaller scale. We therefore plan to gradually introduce technologies whose investment rationality is recognized, and to accumulate reductions in the 2030s.

Q Please tell us about raw materials for EAF steelmaking.

A For EAF steelmaking, while our basic principle is to maximize the use of scrap to the extent possible given quality requirements, we recognize the need to use a certain amount of reduced iron from the viewpoint of quality assurance. For the time being, hydrogen-derived reduced iron is not available, so we expect to source natural gas-derived reduced iron from the market. In procurement, we are emphasizing cost competitiveness and working to secure advantageous supply sources.

Q Regarding the conversion to the EAF process, what are your plans for the use of reduced iron and what conditions are prioritized for procurement of reduced iron?

A We believe that the use of reduced iron in addition to scrap will be necessary for the EAF process. Although scrap prices may rise due to tight supply-demand conditions, we believe that these will remain competitive overall. Therefore, the basic policy is to procure and use

a certain scale of reduced iron from the viewpoint of quality assurance, while assuming that scrap is utilized to the maximum extent permitted by quality requirements.

At present, we believe that there is no hydrogen-derived reduced iron available globally, so for the time being, we will procure reduced iron derived from natural gas. While emphasizing cost competitiveness, we are currently searching for suppliers providing favorable procurement terms.

Q Please tell us about the possibility of further conversion to EAFs.

A We plan to implement EAF conversion at the three bases in Yawata, Hirohata, and Shunan, but further expansion remains an option. That said, external conditions such as tight supply-demand conditions for scrap and constraints on electric power infrastructure are important decision-making factors, and we need to make a comprehensive judgment based on these.

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