FOREWORD

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Two major technological trends accompanied by innovation are now the focus of global attention. One of these trends is GX (Green Transformation). Customers and investors have already begun to select companies around the world based on their efforts to achieve carbon neutrality, which means substantially eliminating greenhouse gas (GHG) emissions. Those that are slow to act will be forced out, and companies in the steel industry will not be an exception. The second trend is the creation of technological value by DX (Digital Transformation). Until now, the Japanese steel industry has led the world by upscaling its facilities, achieving higher efficiencies and expanding the use of low cost raw materials, but we are now truly entering a period of change.

Our elders have long taught that the mission of the ironmaking division is "to supply pig iron i) safely (complying with CSR), ii) stably (securing the required quantity) and iii) economically (reducing costs). Now, "reducing CO_2 emissions (when producing pig iron)" has been added to the priorities of these values, and changes are also occurring in GX, which is positioned as a top priority issue, on the same level with i) safety. Conventionally, the issue had been how to use carbon efficiently without waste in the ironmaking process, and how to reduce the use of carbon to the minimum limit in order to achieve "low carbon." Recently, however, the center of this issue has shifted to how to substitute hydrogen for carbon as a reducing agent, in other words, "decarbonization." While this has also led to a renewed recognition of the importance of the role of carbon in the reduction of iron ore, heating and gas permeability (and lowering of the melting point by carburization, etc.) in the blast furnace process, which has a history of more than 100 years, we intend to make further efforts to develop technologies for achieving carbon neutrality in cooperation with the related departments. This Special Issue of JFE Technical Report presents innovative technologies for carbon neutrality, Ferrocoke and the Carbon Recycling Blast Furnace.

The second major technological trend is DX.

For example, in the blast furnace, it has become possible to detect the signs of abnormal furnace conditions and predict the heat condition of the furnace 8 to 12 hours in advance by

applying CPS (Cyber Physical System), which reproduces the phenomena in the blast furnace in cyberspace based on the data from more than 1 000 sensors, and this is contributing to stable operation by preventing serious blast furnace trouble. Although AI-based blast furnace operational guidance systems such as the "GO/STOP system" and the "Expert system" were developed during the 1980s and 1990s, the largest difference between today's technologies and those systems is the fact that high speed calculations on models incorporating large volumes of sensor data has now become possible thanks to improvements in sensing technologies by the development of new measuring devices and dramatically improved computer performance. Moreover, the trend of the DX transformation is not limited to blast furnace technology, but also extends to a wide range of other applications in the raw material preparation and sintering process and in the field of coke. In addition to DS (Data Science) use technologies for the blast furnace, this Special Issue also presents examples of DS introduction in the state-of-the-art sinter plant and yard operation at JFE Steel's West Japan Works (Fukuyama District).

In any case, the future image that we conceive in advance in order to overcome the challenges of these two great transformations is both an urgent and an important issue for the ironmaking division. From this perspective, we will devote the greatest possible effort to technological development to solve these problems based on the JFE Group's Corporate Vision of "Contributing to society with the world's most innovative technology."