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Analysis of Data and Information Flow for Pipeline in Permafrost Area

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Abstract: Since the G20 summit in 2011, South Korea who was dependent on foreign energy needs of 97% receives natural gas from Russia from 2015 to 30 years, but South Korea is a situation of scarce experience and skills of pipeline project in permafrost area. In this study, we kept the target for analyzing the data and information flow of the pipeline projects in permafrost area, and the ultimate goal is set to developing the hierarchy structure of design and construction data for an efficient administration of the project. In order to develop that structure, Configuration Management was introduced and through this method, it is expected to be used to build the overall information management system in O&M phase.

Keywords: Data Breakdown Structure, Pipeline, Permafrost Area, Information Management

1 Introduction

1.1 The Purpose of Study

Since South Korea is relying on 97% of the energy supplied from overseas, it is essential to secure alternative energy. Since 2011 G20 Summit, it became available to receive natural gas from Russia from 30 years in 2015 with mutual cooperation agreement for the procurement of natural gas/oil and resources. This makes South Korea possible to be a pioneer in extreme climatic regions. However, South Korea is still lacking of the design and construction experience of projects in the pipeline and skills to manage the vast amounts of information generated by the project in permafrost area. It is therefore an object of this study is to analyze the data and information flow of the pipeline project in permafrost area. In addition, the ultimate goal of this study is to develop hierarchy structure of design, construction data for efficient project management in harsh climates.

1.2 The Scope and Method of Study

The scope of the research is limited to management of data generated in the EPC and O&M phase of the pipeline projects in the permafrost area.

In order to achieve the objective, it is needed to review the domestic and foreign research articles related to the study subject, and analyze the characteristics of business processes in the pre-construction phase with key information of the pipeline project in permafrost area. Moreover, the methods to incorporate the information throughout the life cycle is presented for the purpose of efficient connection between data of the project work step.

2 Consideration of Precedent Studies

2.1 Definition of Extremely Cold Regions

Extremely cold regions refers to a region having a less than 0°C temperature during the two continuous winter and summer period between them. Permafrost areas are widely distributed in Siberia, Alaska, northern Canada, and northern China. Also, it has the active layer which is the ground layer repeating freezing and thawing in accordance with the change of seasons, and at its bottom, the permafrost are is present for holding the permanent freezing (0°C or less) irrespective of the temperature change on the ground.

2.2 Characteristics of the Pipeline Construction in Permafrost Area

Permafrost areas are changed to the thickness of the melting surface of active layer, and because of this situation, permafrost boundary depth is also changed due to changes of temperature in all year round. Due to the changes of the foundation temperature in permafrost area, frost heaving and thawing settlement happens on the foundation.

As a consequence, the behavior change on the foundation such as differential settlement of the foundation soil occurs due to changes in ground-based foundation bearing capacity change and the melting of ground ice. The strength and prediction/evaluation of the bearing capacity of the ground in permafrost area in very important. Therefore, it could be a problem during design· construction phases by occurring changes to behavior foundation such as bearing capacity change due to freezing/melting of the foundation, strength reduction due to melting of frozen ground, and soil settlement. Recently, structural monitoring system has been introduced, and it is required to existing safety check or continuous measurement with different approach to precious safety inspection.

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2.3 Analysis of the Need for Data Management

It is essential to monitor for pre-anticipation in the operation and maintenance aspects, and manage occurring data produced and accumulated in real time by combining the information technology IT such as the management system. As it is also necessary to maintain large-scale data generated in planning, design, procurement, and the construction phase, looking at as a whole, it can be concluded that systemic management is needed for the occurring data of the pipeline in permafrost area

3 Data & Information Flow of the pipeline in permafrost Area

3.1 The Concept of Configuration Management

Configuration management is applied as part of a technique that can be traced in the event of a change management. It is usual to be applied to client's requirements management, current project progress, and concordance comparing management with the owner's requirement.

Configuration management plays a role as a comprehensive technology management system which make important pipeline facilities and equipments ensure their own function. It is applied for the purpose of preventing the loss of data in the process of moving at each EPC and O&M phase and managing the flow of data throughout the life cycle by extracting the data effectively from the previous stage.

3.2 Analysis for Information Integration in Life Cycle

TABLE I
CONFIGURATION DATA IN ENGINEERING PHASE

Engineering WBS

Major Class	Middle Class	Minor Class	Activity
1. Pipeline Engineering	1.1 Engineering Planning	1.1.1 Pre-project Research	
		1.1.2 Standards, Codes & Regulations	
		1.1.3 Conditions & Requirments	1.1.3.1 Typical/Special Pipeline
			1.1.3.2 Gas Treatment Plant
			1.1.3.3 Compressor Stations
			1.1.3.4 Gas Refrigeration Stations
			1.1.3.5 Gas Distribution Stations
			1.1.3.6 Meter Stations
			1.1.3.7 Valves. & Pig Launcher/Receiver Facilities
			1.1.3.8 Corrosion Protection & Detection Systems
			1.1.3.9 Telecommunications Towers
			1.1.3.10 Access Road
	1.2 Basic Engineering	1.2.1 FEED Engineering	1.2.1.1 Project & Scope Definition Review
			1.2.1.2 Site Identification & Evaluation
			1.2.1.3 Concept Development
			1.2.1.4 Cost Estimating & Schedule Development
			1.2.1.5 Alternatives Evaluation
			1.2.1.6 Feasibility Studies
			1.2.1.7 Preliminary Engineering - PFD, UFD, P&ID, PCD
			1.2.1.8 Process computer simulation modeling
			1.2.1.9 Identification & Investigation of Long Lead Items
			1.2.1.10 Hazard & Operability Studies / Hazard Identification
	1.3 Detailed Engineering	1.3.1 Construction Type Engineering	1.3.1.1 Structural
			1.3.1.2 Process
			1.3.1.3 Instrumentation & Telecommunications
			1.3.1.4 Electrical
			1.3.1.5 Mechanical
			1.3.1.6 Piping Layout
			1.3.1.7 Permitting Support
		1.3.2 Category Engineering	1.3.2.1 Line Pipe
			1.3.2.2 Welding
			1.3.2.3 Protective Coatings
			1.3.2.4 Cathodic Protection
			1.3.2.5 Valves, Flanges & Fittings
			1.3.2.6 Scraper Trap Facilities
			1.3.2.7 Class Location
			1.3.2.8 Minimum Depth of Cover
			1.3.2.9 Pipeline Crossings
			1.3.2.10 Buoyancy Control
			1.3.2.11 Pressure Testing
			1.3.2.12 Signs & Markers
			1.3.2.13 Permanent Access Roads
			1.3.2.14 Unspecified Conditions

For establishing efficient data systems, it is required to build an effective linkages between the data at each step. In order to determine the link with Final Data in EPC phase, As-Built Data in completion phase, and Field Data in O&M phase, it is extracted to the shaped information generated at each EPC and O & M phase.

It is planned to build a system to integrate information across life cycle focused on embellish management, baseline management, margin management, and change management using the V-Model based on the extracted data from each phase.

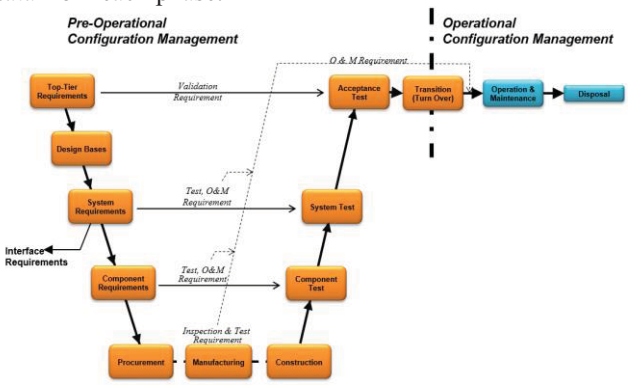

FIGURE I
DATA FLOW THROUGH V-MODEL

4 Conclusion

According to the characteristics of pipeline project in the permafrost area, there would be specific matters otherwise the not extreme pipeline projects. Therefore, the need for data management is even more apparent. For this, the shape information generated at each stage was derived to manage the EPC and O&M data efficiently through the introduction of the concept of the configuration management data. In addition, a life-cycle information integration method was presented by utilizing the V-Model with derived information.

The results of this study are expected to be used to build the overall information management system of the maintenance phase.

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