# Harmonization of a Pyroprocess System Engineering and Project Management

Hee Seong Park<sup>\*</sup>, Young Choi, Ho Dong Kim Korea Atomic Energy Research Institute, Fuel Cycle System Engineering Technology Development Division, 1045 Daedeokdaero, Yuseong-gu, Daejeon, 305-353, Korea <sup>\*</sup>Corresponding author: parkhs@kaeri.re.kr

## 1. Introduction

A pyroprocess engineering and project management system for pyroprocess facility was designed in order to construct PRIDE facility successfully by using systems engineering and requirements engineering. An integrated project management system by applying ISO/IEC 15288 Systems Engineering-System Lifecycle Process was established. A WBS(Work Breakdown Structure) for pyroproces facility was implemented to organize research and development project and to improve problems.

A unified database system is described in order to the technical consolidation between others project, a collaboration that shares the pyroprocess information, consistent communication, and the visability of the R&D status.

#### 2. Methods and Results

In this section some of the system engineering and requirements engineering related to design of a pyroprocess system engineering requirements and project management are described. Top requirements of the PRIDE and pyroprocess system processes are explained.

#### 2.1 Creation of Nuclear Fuel Cycle System Engineering

System engineering is essential technology to the successful development of complex facilities. Effective requirements engineering lies at the heart of an organization's ability to guide the ship and to keep pace with the rising tide of complexity facility. Even though nuclear fuel cycle facility that treats with spent fuel has been applied with this technology, pyroprocess facility has never been adapted to this technology. This paper suggests a methodology of system engineering for nuclear fuel cycle facility by using ISO/IEC 15288[1]. This system lifecycle process are adaptable to any part of a system hierarchical structure and can be applied any systems that consist of the H/W, S/W, human being, and process.

Requirements that need with each step during full lifecycle of a nuclear fuel cycle facility was extracted through analyzing requirements of nuclear fuel cycle facility which treats with spent fuel and requirements that was proposed from ISO 15288 technical process.

A nuclear fuel cycle facility of new concept is showed in Fig.1.



Figure 1. Nuclear fuel cycle system engineering applied with ISO 15288 technical process

#### 2.2 Define of Pyroprocess System Process

The INL(Idaho National Laboratory) had proposed the principal functional and operational requirements for the AFCF (Advanced Fuel Cycle Facility), which is intended to be the world's foremost facility for nuclear fuel cycle research, technology development, and demonstration[2]. The AFCF shall include large shielded and remotely maintained areas to validate, demonstrate, and improve spent fuel treatment processess, fuel fabrication processes, and safeguards monitoring. Total 13 high-level requirements are defined after considering requirements and missions that need with each process of PRIDE facility (Fig. 2).

| 214 | I: PY | P14, OR |                          |   |
|-----|-------|---------|--------------------------|---|
|     | 1.    | 97-N8-A | I 🔝 🗈 NRF-RID & EI       | 최중보고서 📰 🛅 13 (A) 📰 🛅 PYRO_REQ 🔛   |
|     | T     | 콘인방호    | 92                       | 요구사상내용  |
|     | 01    | B       | No. of Concession, Name  | We are the second s  |
| 1   | B     | REQ.1   | 치리 물질                    | 시스앱은 거은 부지 및 실비를 고객하여 공정의 유효성을 확인하기에<br>적중한 음향을 감도록 해야 한다.  |
| 2   | D     | REQ.2   | 핵연료 안입 처장 및<br>인물        | 시스템은 처리 대상 핵연료를 인밀,저장 및 연충 할 수 있어야 한다.  |
| 3   | B     | REQ.3   | 전처리                      | 시스템은 인일된 핵인료를 분발하여 밝혔 형태로 가용할 수 있어야 한다  |
| •   | B     | REQ.4   | 봉김·장해 화원, 장현,<br>계련      | 시스앱은 전해화된, 전해전면, 전매계련 등의 IPARO 공격은 개최 U입<br>TRU를 분간할 수 있어야 한다.  |
| 5   | D     | REQ.5   | 분리물질:처리,저장               | 사스앱은 분리된 용용을 처리 및 저장 할 수 있어야 한다.  |
| 6   | D     | REQ.6   | 앞곳 생산                    | 시스앱은 응용없은 영곳 형태로 생산할 수 있어야 한다.  |
| 7   | D     | REQ.7   | 第기문 처리 및 저장              | 사스업은 학생되는 第기왕을 분석, 인증, 처리, 보장, 검사 및<br>모니터왕하고 저장받 수 있어야 한다.   |
| 0   | D     | REQ.8   | 부대설비                     | 시스앱은 원격운전 장치, 방사농 속장 장치, 불장치 등의 부대설비를<br>갖추어야 한다.   |
| ,   | -     | REQ.9   | 회수 U, PurNP AM CM<br>존합물 | 사스앱은 혼합물을 고속로 연료로 제품용할 수 있어야 한다.  |
| 10  |       | REQ.10  | 인전조치 및 핵훈산<br>저협성        | 사스앱은 IAEA 의 안전조치성과 핵확산저합성을 준수하고 이를 위한<br>열비를 감수어야 한다  |
| 11  | D     | REQ.11  | 18년 안 문 건                | 사스엘은 데이터 수집 및 관리, 시스엘 케이 등을 위한 IAC 인프라를<br>감추어야 한다  |
| 12  |       | REQ.12  | 88                       | 시스템은 필자력법에 챙기된 안전규정을 준수해야 한다.   |
| 13  | D     | REQ.13  | #920                     | 시스열은 DOE Order 414.1C, Quality Assurance, Section 48 및 100'R,<br>630 Subpart A, Quality Assurance Requirements, Section 930.1228<br>기술된 Orbenia를 인족해외 한다. |

Figure 2. Top requirements for the PRIDE from treatment capacity to quality assurance

#### 2.3 Pyroprocess Subsystem and Component System

Requirements and an inner interface of the pyroprocess subsystem and component system were defined. An inner interface divided into 4 parts; ① High-end process includes vol-oxidation and off-gas. ② Pyroprocess includes electrolytic reduction, electro refiner, electro winning, and salt waste process. ③ System engineering technology includes remote operation, safeguards, and transportation/storage. ④ Utilities include the PRIDE facility. Figure 3 shows an inner interface between the components of the PRIDE.



Figure 3.An inner interface between the major process of the PRIDE based on system engineering procedure

#### 3. Conclusions

As high-level requirements proposed to this paper were sample data, more requirements such as a core function, safety, security, outer interface, procurement and maintenance will be defined in the next stage. System engineering and requirements engineering technology will be provided a need strategy in order to verify a validity of a pyroprocess technology in design, test, and operation stage.

### REFERENCES

[1] IEEE Computer Society, IEEE Standards for Application and Management of the Systems Engineering Process, IEEE Std 1220-2005, 2005.

[2] Charles V. Park, High-Level Functional and Operational Requirements for the Advanced Fuel Cycle Facility, INL/EXT-06-12059, 2006.