Feasibility Study of Fuel Debris Cutting and Dust Collection Technology for Innovative Approach
<IHI Corporation>

Purpose and Goal

Confirm the cutting performance (safety/cutting speed) for laser cutting with high cutting capability and liquid nitrogen cutting (NitroJet®cutting) with high safety operation using simulating fuel debris materials (degree of hardness/fusion point) and study the feasibility including site applicability..

Overview and Feature

<Study item>

(1) Basic plan for realization of proposed technology

・Develop the system with laser cutting and dust collection function and study its feasibility.

・Set each specifications and study its feasibility for each system components.

・Study safety cutting for zirconium. (Laser/NitroJet®cutting basic testing)

(2) Study for the site application

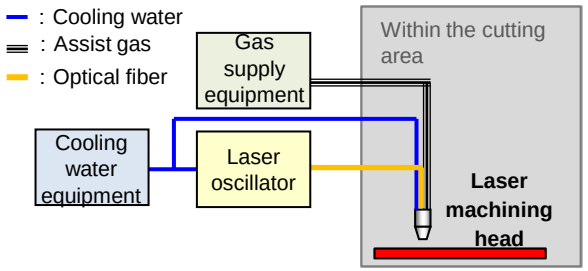
・Make a plan for extracting concerns and its solution to realize the fuel debris cutting.

(3) Study the process, structure and cost to realize proposed technology

・Study the process, structure and cost required for the period from the development of the laser cutting equipment with dust collection function to the site application.

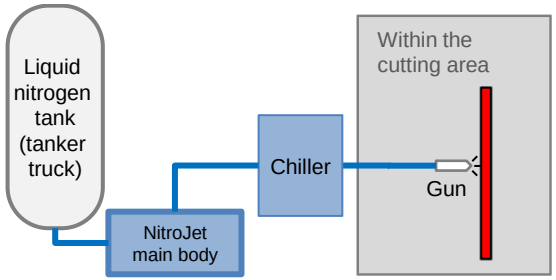
<Outline and characteristic of cutting technology in this project >

Laser cutting



・High cutting performance, and high cutting speed
・Reaction force given to the remote control equipment during cutting is small.
・Low secondary wastes generation (fume and sputter are generated)
→Since it is thermal cutting, confirm the safety of zirconium cutting. (basic cutting test)

NitroJet®cutting



・ Good cutting performance
・ Thermal impact is small. (suitable for the cutting of material incompatible with heat input.)
・ Less amount of secondary wastes generated (abrasive material is generated and liquid nitrogen is evaporated.)
→Confirm cutting performance for the hard materials equivalent to the debris (basic cutting test.)

<Focusing point in the project and strong point>

- ✓ **Diversification in the cutting technology to realize the debris retrieval is important.**
  (Challenge to the technology to cut quickly and safely)
- ✓ **Focusing on the cutting test, to improve the site applicability.**
  (need to cut debris under the condition where debris properties are unknown.)
- ✓ **Study in realistic way based on the remote laser cutting technology in the air which has been delivered as a waste dismantling equipment under the condition of high dose radiation environment.**

Output so far/Output expected

<Output so far>

(1) System related

- System structure: Study the laser /NitroJet®cutting system structure and dust collection system.
- Specifications: Clarify the cutting performance and radiation resistant and dust collection function specifications and study the specifications for each component.

(2) Basic cutting test related

- Cutting test material selection/order placement.
- Safety study related to zirconium cutting
- Make a plan for laser /NitroJet®cutting test.

⇒Narrow down the specifications capable for site application considering the dust collection system (preliminary) and fuel debris retrieval method.

<Basic cutting test outline>

Laser cutting

·Set safety cutting requirements for Zr (cutting requirements 1)
·Conduct test for cutting test for the material shown below within the range in the cutting requirements 1.

NitroJet®cutting

·Check the cutting performance for respective material shown below .
·Set cutting requirements embracing all materials.

<Cutting test material>

Expected parts	test material
Cladding tube	Zr
Fuel debris (Hard material)	ZrO_2
	Al_2O_3
Internal structure (difficult-to-cut material)	Inconel (NCF600)

Cutting technology	Cutting material	Check item of basic cutting test
Laser	(1)Zr	Establish the condition preventing the water –Zr reaction.
	(2)NCF600	Compatibility of (1) and NCF600 cutting
	(3)Al_2O_3	Compatibility of (1) and Al_2O_3 cutting
	(4)ZrO_2	Obtaining cutting data
NitroJet®	(5)NCF600	Cutting performance for difficult-to-cut material
	(6)Zr	Compatibility of (5) and Zr cutting
	(7)ZrO_2, Al_2O_3	Obtaining cutting data

<Output expected>

- ✓Specifications with laser cutting equipment with feasible dust collection function (including installation construction, and remote operability)
- ✓Results of verification for zirconium safety cutting.
- ✓Cutting of high fusion point material/ high degree of hardness material, and cutting data corresponding to the physical property
- ✓Extraction of concerns for site application, resolution and results of study for the schedule.
- ✓Study results for development process, organizational structure, approximate cost for development of laser cutting technology, dust collection system and site application.

Overall Schedule

	Overall schedule	FY 2014 Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
(1) Study the feasibility of basic plan to realize the proposed technology.	· Develop the system with laser cutting and dust collection function and study its feasibility.	System specifications (1st determination)					
	· Set each specifications and study its feasibility for each system components				▽ Determine the delivery/remote specifications		
	·Study the safety cutting of Zirconium (implementation of laser /NitroJet®cutting basic test)	Select material /place an order, establish test method			▽ Start cutting test		
(2) Study for the site application	· Make a plan for extracting concerns and its solution to realize the fuel debris cutting.						
(3) Process, structure and cost to realize the proposed technology.	·Process, structures and cost from the development of laser cutting equipment with dust collection function to the site application.						Including summary