

## Extensive Application For Destruction Of Various Hazardous Items By DAVINCH Lite System With High Mobility



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- **DAVINCH Lite system with high mobility**
- **Application of DAVINCH Lite**
  - Destruction test for hazardous items
    - Nerve agents
    - Smoke agents
    - Conventional ammunition
  - Explosive capacity
  - Examples of donor charge assembly design and cycle time
- **Further development**
- **Summary**

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# DAVINCH Lite with high mobility

New DAVINCH system “**DAVINCH Lite**” has been constructed with high mobility.

Outrigger function to install detonation chamber without a crane

20ft containers for off-gas treatment module to make transport and installation easier

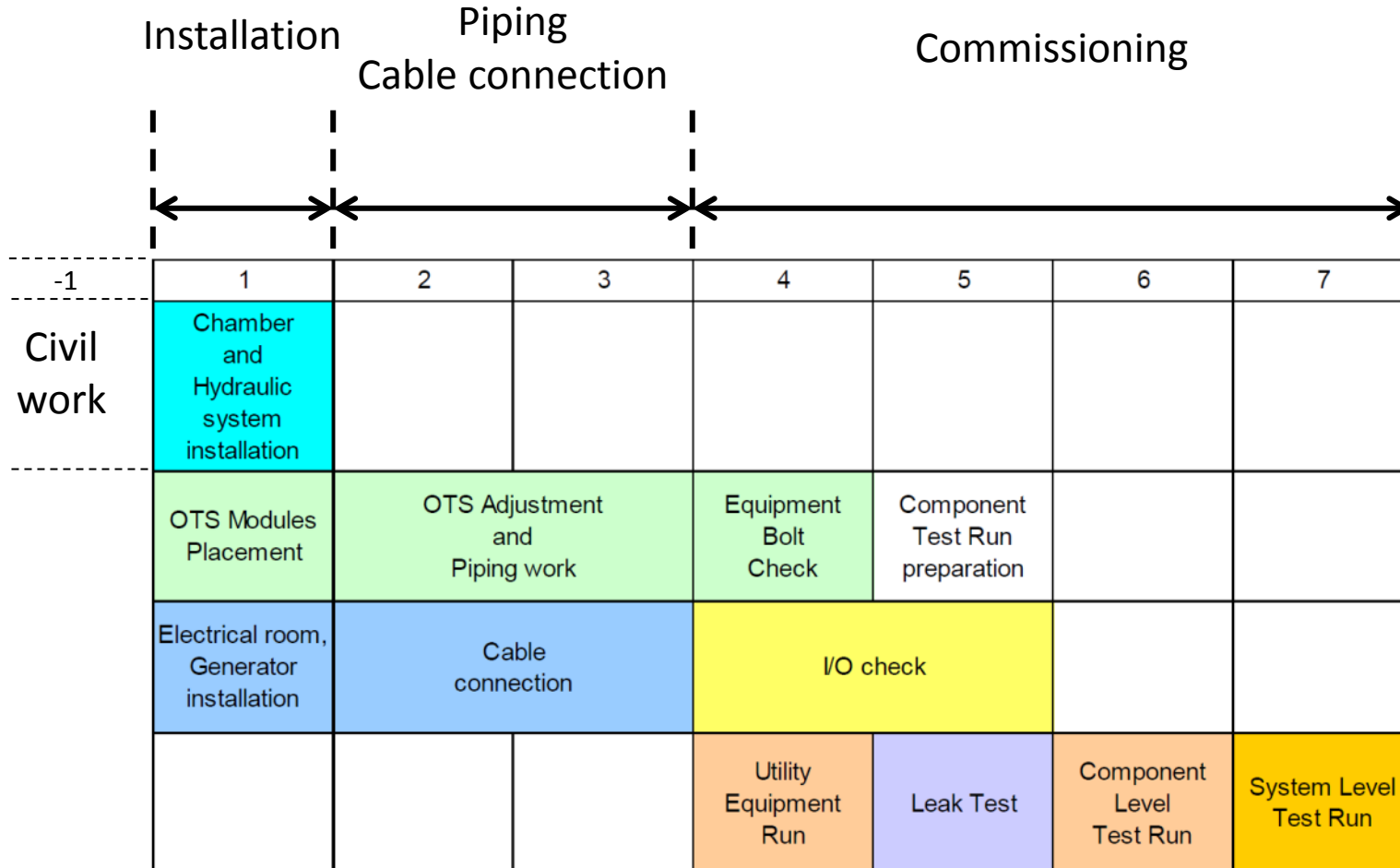


Outrigger

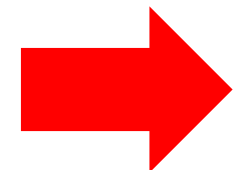


# DAVINCH Lite with high mobility

Duration of deployment is estimated to be **7 days** based on the demonstration in Japan.



Ready for operation



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# Target of destruction

DAVINCH Lite can be applied to destruction of various hazardous items.

**Destruction tests with DAVINCH Lite has been carried out.**

## Chemical agents

DA, DC

**GB (surrogate)**

HD, L

**VX (surrogate)**

Phosgene

## Hazardous materials

**White phosphorous**

**HC (Smoke)**

## Conventional ammunitions

**Munition with heavy steel shell**

**Red:** Test target

**Black:** experienced  
with DAVINCH

HC: Hexachloroethane

# Nerve agent

## Destruction test: Surrogates of Nerve agents

### Specification of M55 rocket

substances	fill weight	size and specification	material
<b>GB</b>	9.3 lb (5 Kg)	1.98m L x 115mm O.D. with burster and propellant	aluminum
<b>VX</b>	9.3 lb (5 Kg)	1.98m L x 115mm O.D. with burster and propellant	aluminum

### Specification of simulated ammunitions for M55 rocket

surrogate	fill weight	size and specification	material
<b>DMMP (for GB)</b>	5.3 lb (2.4Kg) +Ethylene Glycol 5.0 lb (2.3Kg)	1.6m L x 110mm O.D. with burster and propellant	aluminum
<b>Malathion (for VX)</b>	5.8 lb (2.65 Kg) +(Xylene + Ethylbenzen) 5.8lb+2.65Kg)	1.6m L x 110mm O.D. with burster and propellant	aluminum

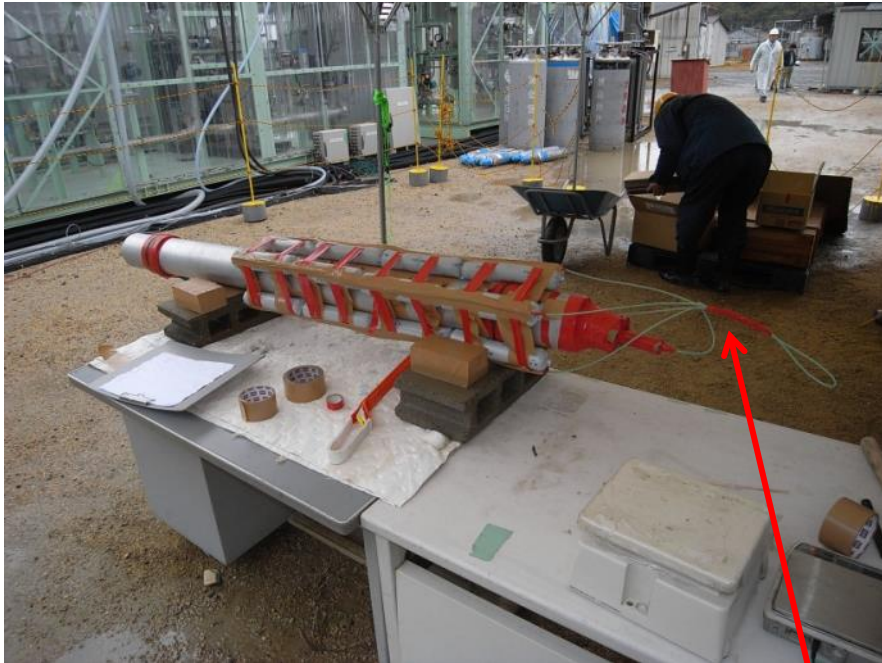
DMMP: Dimethyl methylphosphonate



# Nerve agent

## Preparation

Donor charge was placed on 4 lines along the body with detonating cord to make simultaneous detonation for implosion.



Detonating cord

# Nerve agent

After detonation

**Simulated ammunition was completely destroyed.**



White particle: aluminium oxide



# Nerve agent

Residue quantitation results of the tests

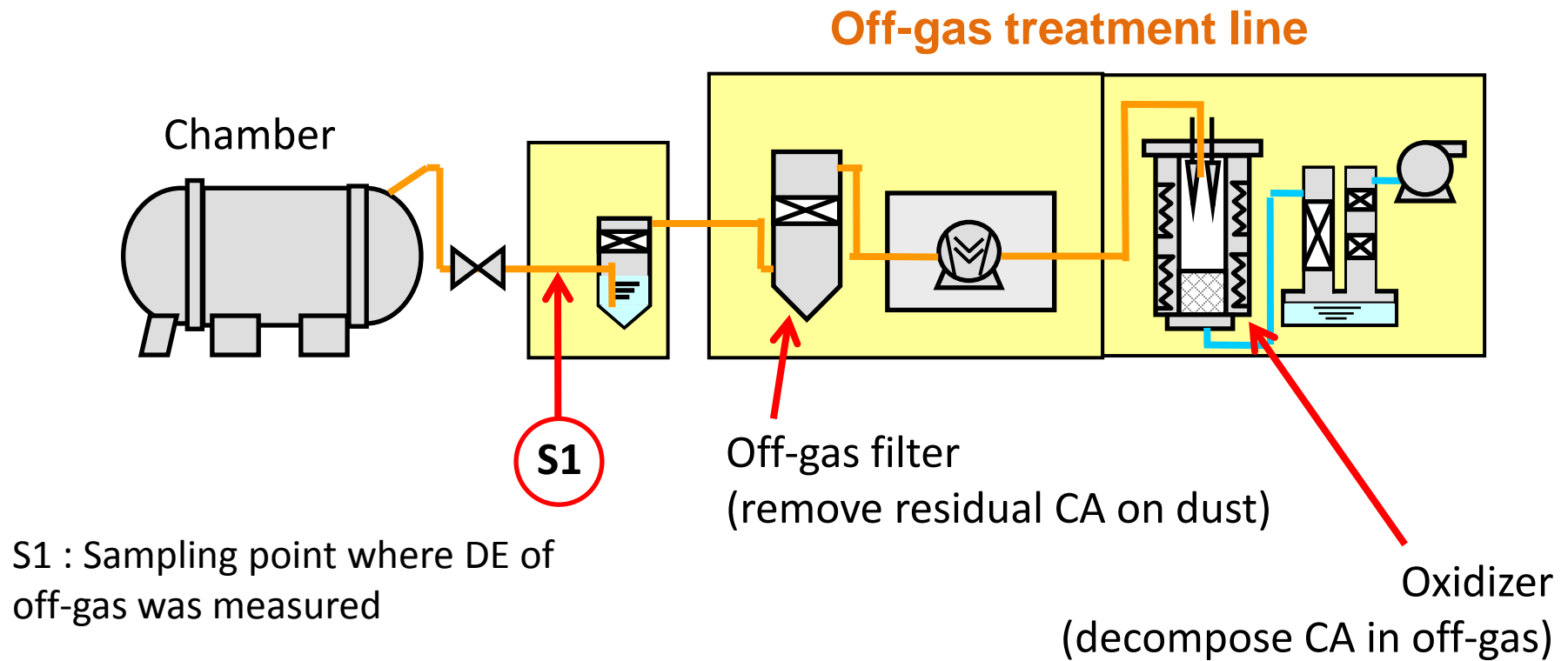
**High Destruction Efficiencies are achieved.**

		Result	unit	2013/12/18 DMMP	2013/12/19 Malathion
Residue	Gas(S1)	Volume	Nm3	24.14	30.07
		Concentration	mg/Nm3	0.0001	0.00001
		Quantity	mg	0.0024	0.0003
	Dust	Total Weight	kg	8.98	16.26
		Concentration	mg/kg	0.001	1.8
		Quantity	mg	0.009	29.268
	Liquid	Volume	L	1.0	1.0
		Concentration	mg/L	0.0001	0.00029
		Quantity	mg	0.0001	0.00029
	Wipe	Surface Area	m2	120.4	120.4
		Quantity/Area	mg/m2	2.33333E-11	2.74833E-10
		Quantity	mg	2.8E-09	3.3E-08
	Others		mg	0	0
	Summary		mg	0	29
Destruction Efficiency	(Gas+Liquid+Solid+Wipe) for reference	%	<b>99.9999995%</b>	<b>99.9989%</b>	
Destruction Efficiency	(Gas only)	%	<b>99.9999999%</b>	<b>99.99999999%</b>	

# Nerve agent

Process flow diagram of DAVINCH Lite

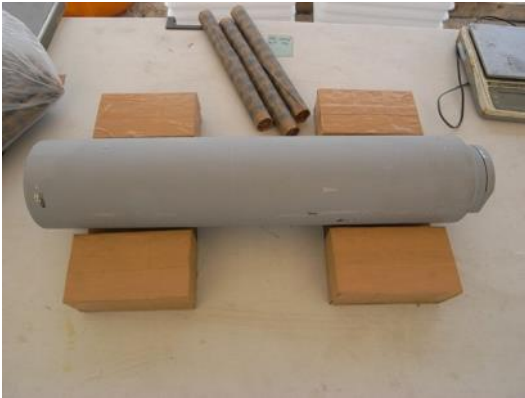
**DAVINCH Lite has back-up equipment for reduction of residual chemical agents.**





# WP and HC smoke

## Simulated smoke ammunitions



Simulated ammunition with white phosphorus



Inside of chamber after detonation

Amount of residual WP in chamber or off-gas line: very small

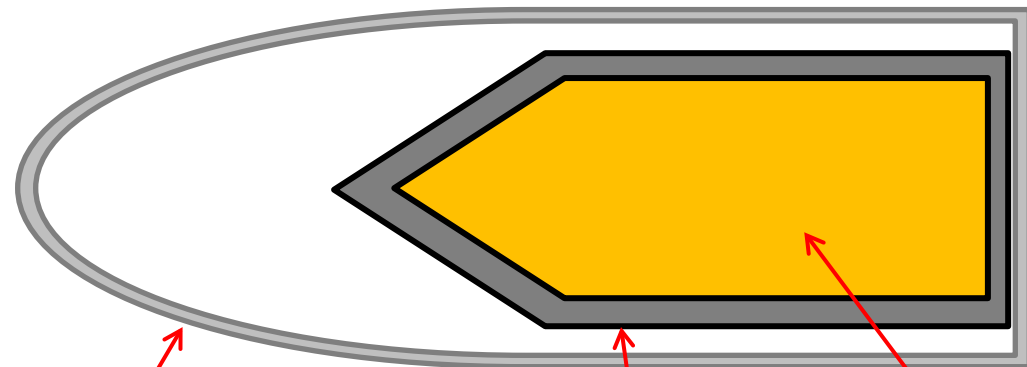
**Simulated ammunitions was destroyed successfully without smoke generation for both WP and HC.**

# Conventional ammunition

Destruction test of conventional ammunition  
Simulated for Warhead of missile



Section-drawing



Outer shell : Aluminum

Inner shell : Steel

burster

# Conventional ammunition

**Conventional ammunition with heavy steel shell was successfully destroyed.**

Donor charge setting  
(C4 explosive)



Steel shell was well destructed  
into small fragments.





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# Explosive capacity

Detonation proof test

Explosion of 30kg TNT-eq. was successfully contained.

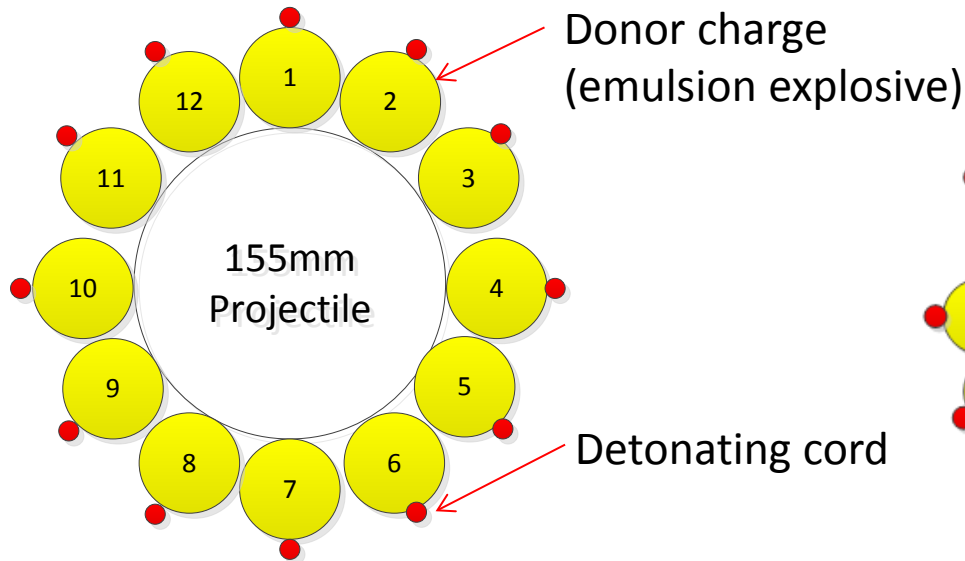
**DAVINCH Lite is feasible for 24kg TNT-eq. with 25% margin**

#	Date	Type of Explosive	Explosive Weight (kg)	Weight TNT eq (kg)	Note
1	3 Dec	Emulsion	18.8	15	
2	5 Dec	Emulsion	32.4	25.9	
<b>3</b>		<b>Emulsion</b>	<b>39</b>	<b>31.2</b>	
4	17 Dec	TNT	15.2	15.2	
5		TNT	22.8	22.8	
<b>6</b>	<b>25 Dec</b>	<b>TNT</b>	<b>30.4</b>	<b>30.4</b>	

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# Examples of donor charge assembly

## Orientation of setting 155mm Projectile



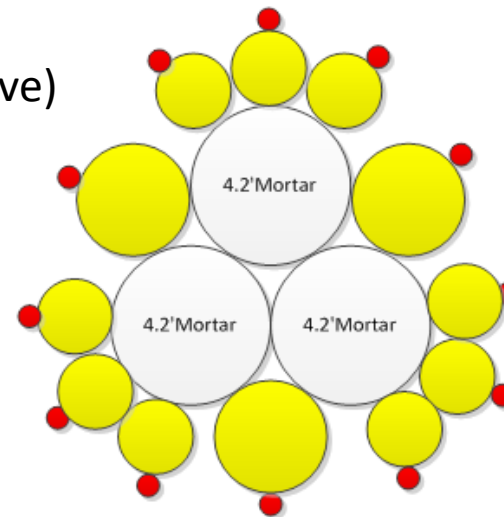
Explosives (TNT eq.)

Inner energetic: 0.2kg

Donor charge : 19.3kg

Total amount: **19.5 kg TNT eq.**  
(NEQ)

## 4.2" Mortar



Explosives (TNT eq.)

Inner energetic: 1.2kg

Donor charge : 19.5kg

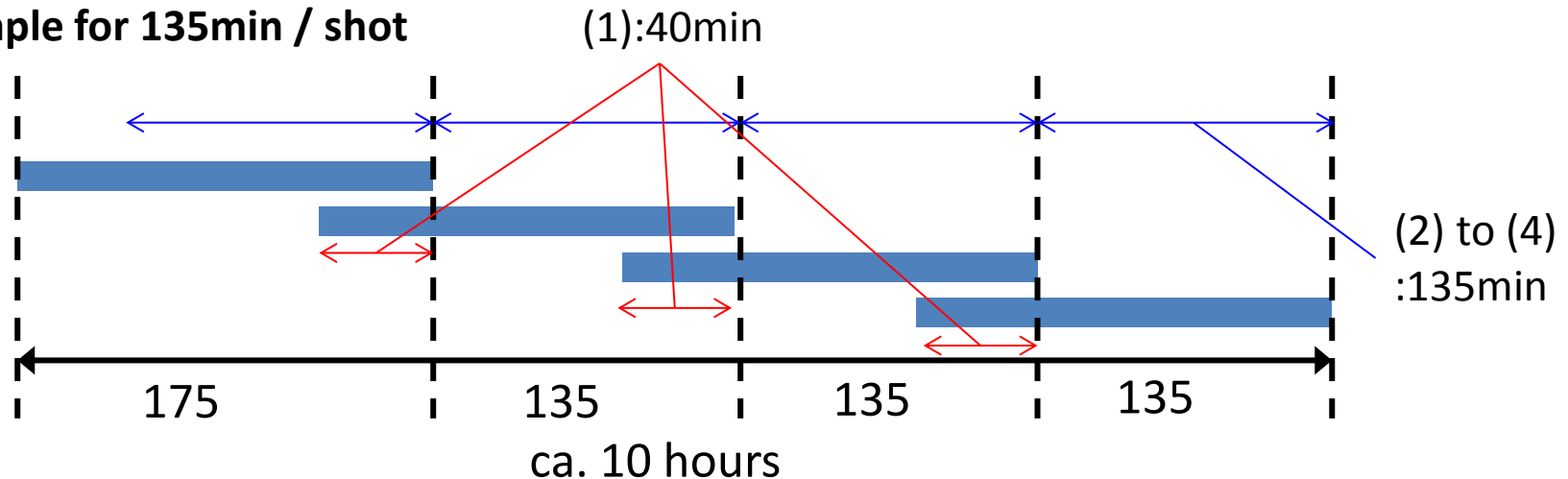
Total amount: **20.7 kg TNT eq.**  
(NEQ)

# Typical cycle time

- (1) Preparation of ammunition : 40 min
- (2) Installation to chamber : 45 – 55 min
- (3) Detonation & off-gas treatment : 60 min
- (4) After detonation : 20 min

Cycle time : **125 - 135 min / shot**

Example for 135min / shot



**Throughput : 4 shots / day (10hour)**

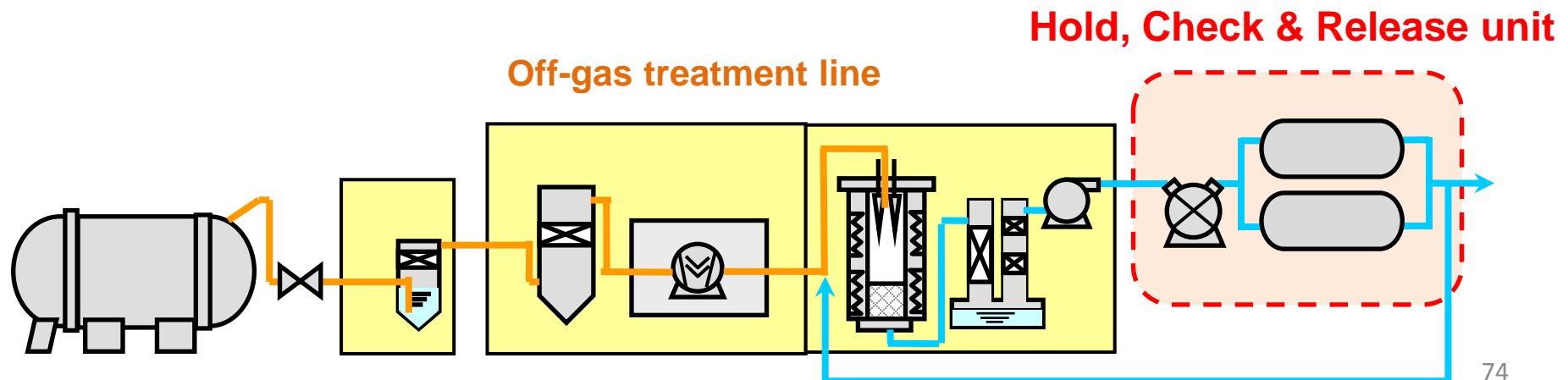
**(135 x 4 + 40 = 580 min / 4 shot)**

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# Further development

**Further development for operability of DAVINCH Lite is being planned.**

- Reduction of cycle time
  - Higher throughput of off-gas treatment
    - **Development of Oxidizer**
- Assurance of much secured environmental emission
  - **Hold, Check & Release system**





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- **DAVINCH Lite has been proved to be able to destroy various hazardous items through destruction performance tests.**
  - ✓ Surrogates of nerve agents
  - ✓ Smoke ammunitions
  - ✓ Conventional ammunitions
- **Donor charge orientation design and operation time have been estimated. DAVINCH Lite can destroy chemical ammunitions with high throughput.**

In addition, DAVINCH Lite has;

- 7 days deployment
- Planning further development

**Application of DAVINCH Lite is widely extended.**