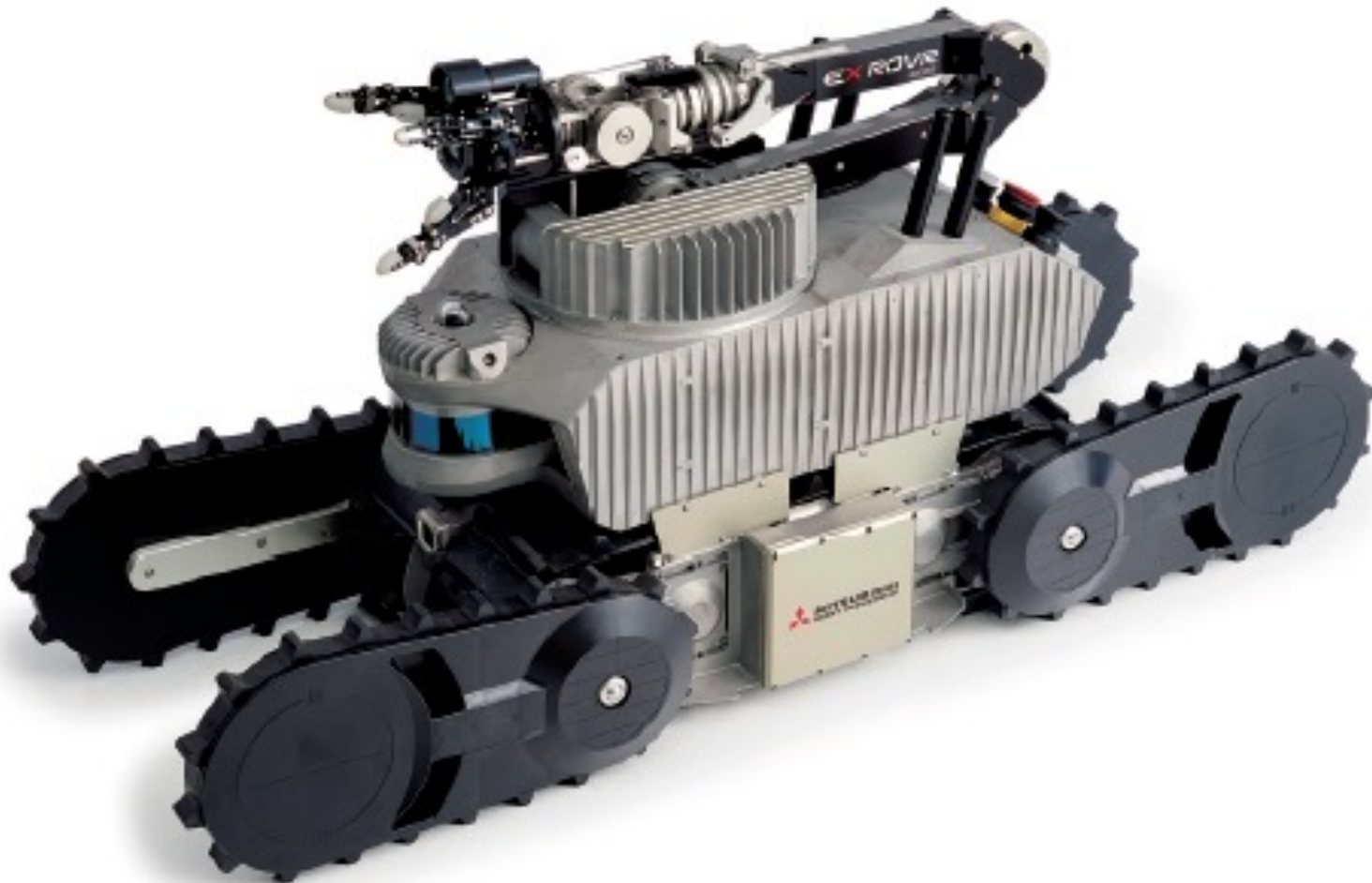


# EX ROVR "ASCENT"

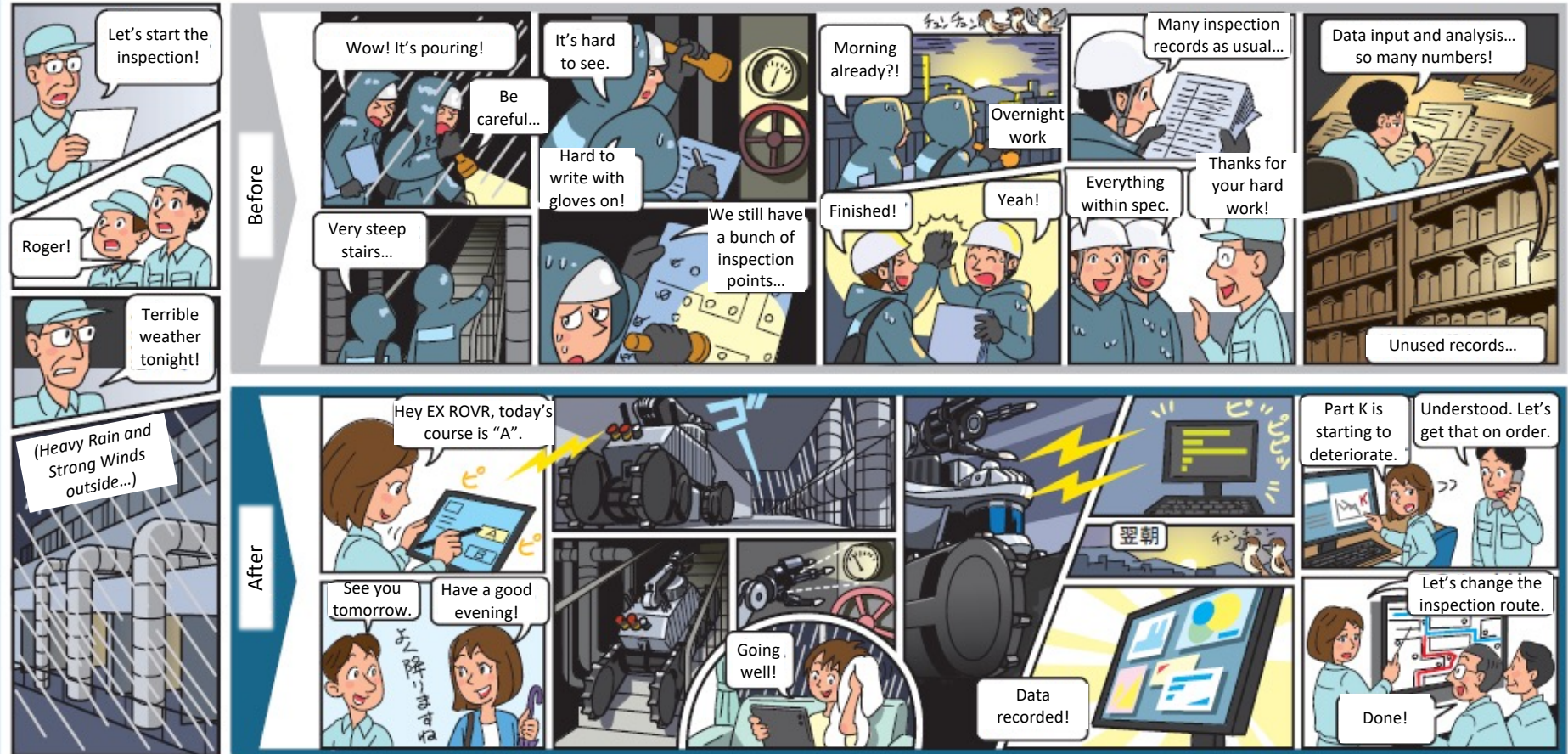
MOVE THE WORLD FORWARD  MITSUBISHI  
HEAVY  
INDUSTRIES  
GROUP



## Use Case, Value to Customers

# Use Case – Autonomous Inspection Rounds

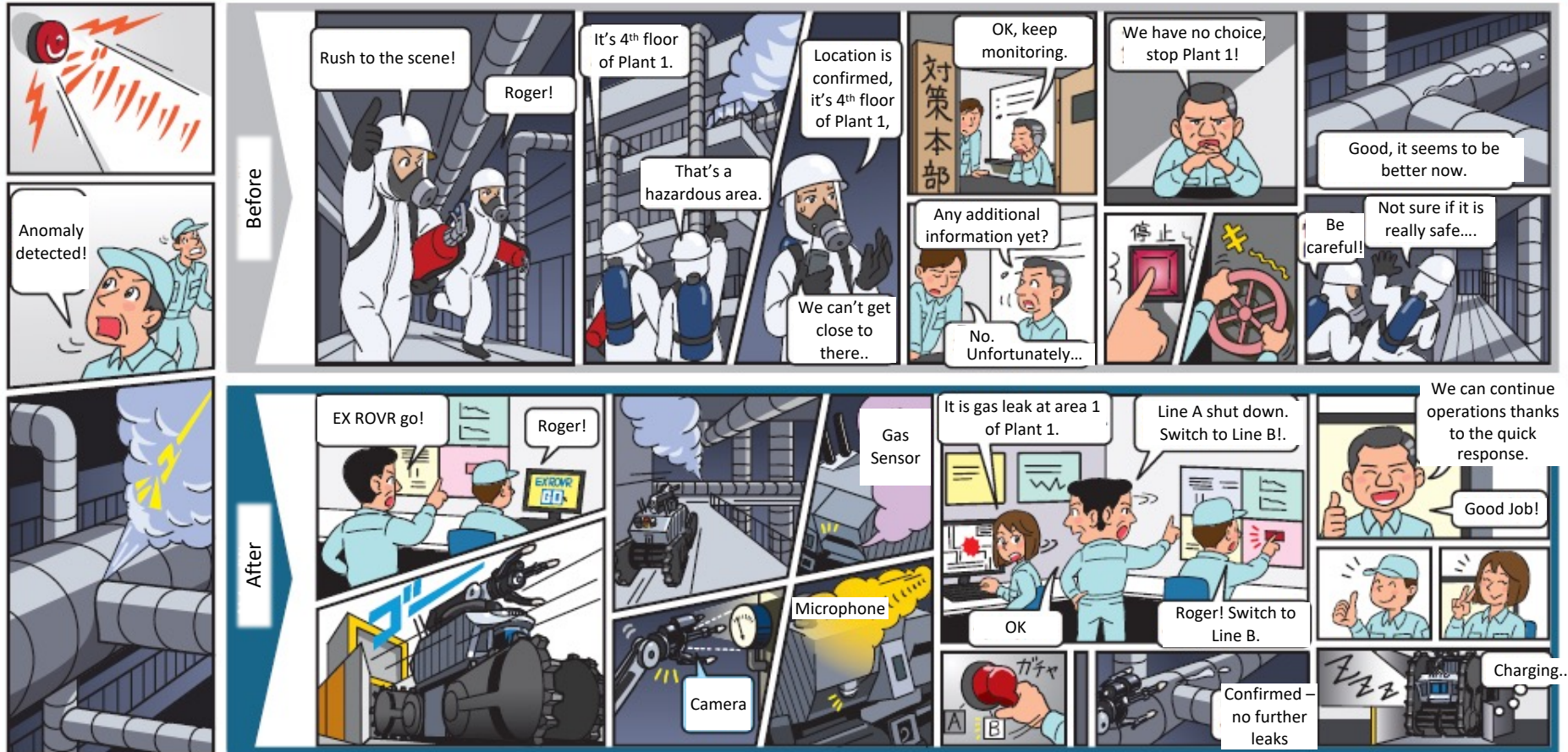
## Inspection Rounds





# Use Case – Incident Response by Remote Control

## Incident Response



## Safer Operation

Removing human operators from potentially dangerous situations

## Cost Efficiency

Performance of highly repetitive tasks in potentially hazardous locations, freeing human operators for more productive jobs

## Highly Repeatable & More Frequent Inspections

Preventing unplanned shutdowns through more frequent inspections

## Digitalized Inspection Record

Digital inspection data analytics; data is fully researchable & trendable (IoT)

## Introduction of EX ROVR “ASCENT”



# EX ROVR "ASCENT" Outline



Integrated IMU (Internal Measurement Unit) and pressurized enclosure explosion-proof protection system including redundant pressure sensor

6 Degree-of-Freedom (DOF) manipulator

Wireless Antenna (Wi-Fi and LTE)

Surveillance Camera

Emergency Stop Switch

Gas Detector

3 Finger Gripper

Omnidirectional Camera

3D-LiDAR (Laser Range Finder)

Rear obstacle distance sensor

Flame proof enclosure explosion-proof lithium-ion battery

Thermal Image Camera (One on each end)

Drive System  
2 main trucks  
4 sub tracks

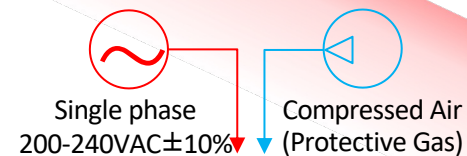
Front and rear cameras for remote control

## EX ROVR "ASCENT" Key Parameter

Length	27.6 – 47.2 inches (700-1200mm)
Width	17.1 inches (450mm)
Height	21.3 inches (540mm)
Weight	154 lbs. (70kg) (approximate)
Speed	0.75 mph (1.2km/h) (on flat terrain)
Lifting	6.6 lbs. (3kg) (by Manipulator)
Certification	ATEX / IECEx Zone 1 compliant

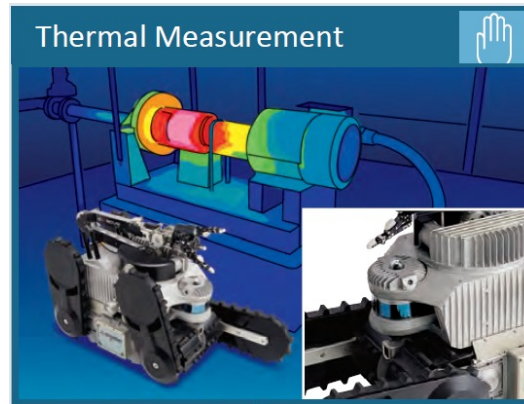
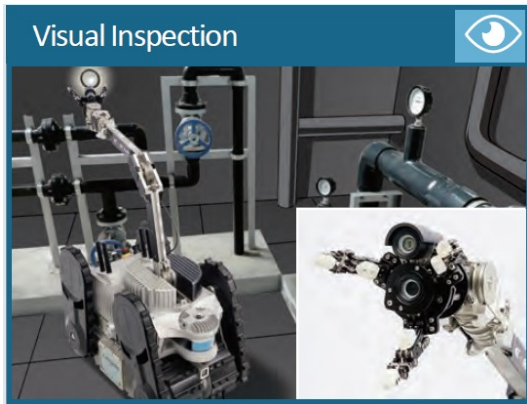
**ZONE 1**

Remote Control PC

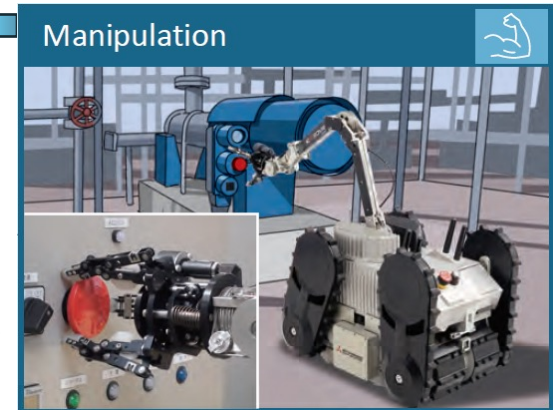


Charging Station (Contactless Charging and re-purging)

# EX ROVR "ASCENT" Key Functions



Five high-value inspection functions contribute to the continued safe operation of the asset.





# EX ROVR "ASCENT" Key Technologies

## Explosion Proof

Complies with regulations in various countries, IECEx, ATEX, Ex2018

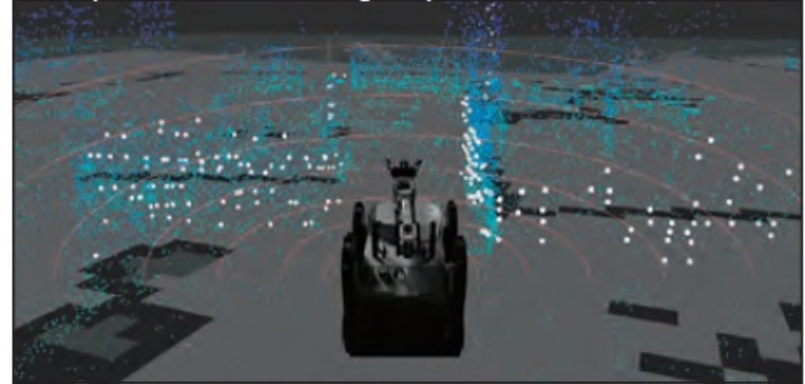
- Gas Class : II B+H2 T3 Gb
- Area: Zone1



## Autonomous Navigation

Performance of autonomous operator rounds even in the complicated environments and low light conditions

- Localization through advanced 3D LiDAR maps
- Fully autonomous obstacle recognition
- Fully autonomous stair climbing ability



## High Mobility

Able to negotiate narrow paths across multiple floors in a complex environment

- Can descend and climb stairs from -45 to 45 degree
- Can turn "on a dime" on a narrow stair case landing

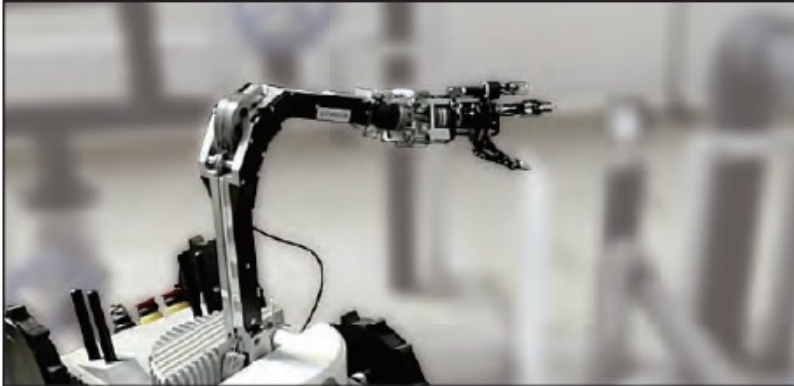


# EX ROVR “ASCENT” Key Technologies

## Manipulator

Capable of complex articulation to position camera and end effector close to the target

- 6 degree of freedom
- End effector with 3 finger gripper for positive contact



## Autonomous Charging

Capable of long run times and quick charging

- Contactless induction charger is explosion proof and can be placed in the hazardous location
- Rapid charging allows for high availability with 2 hours of operation by 2 hours of charging



## Data Management

Mission planning and data validation can be performed remotely from anywhere in the world

- Mission planning inspection waypoints can be set through secure connection via internet browser
- Inspection data is securely stored in the cloud and can be accessed on demand

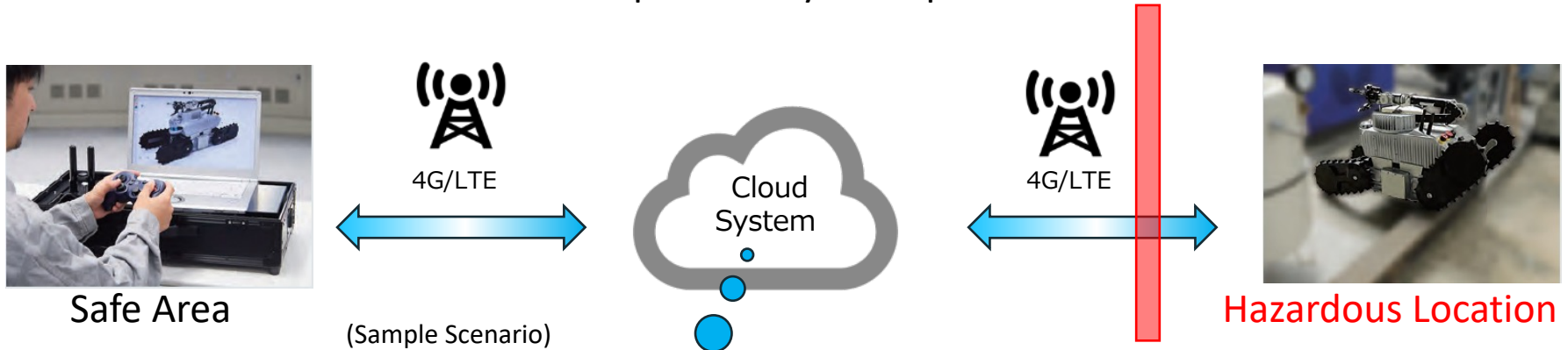


## Process to Set Up and Autonomous Operation



# Remote Access & Scenario Maker

1. 3D map of the plant is created remotely and uploaded to the cloud
2. Scenario is created in the 3D map remotely and uploaded to the cloud



Charging Station

3D map

Route

Stairs

Gauges

Obstacles

nav2viz-Rviz

File Panels Help

RibbonPanel

プロジェクト 実行 編集 オブジェクト

シナリオ

ScenarioEditPanel

ground-level

second-floor

Time

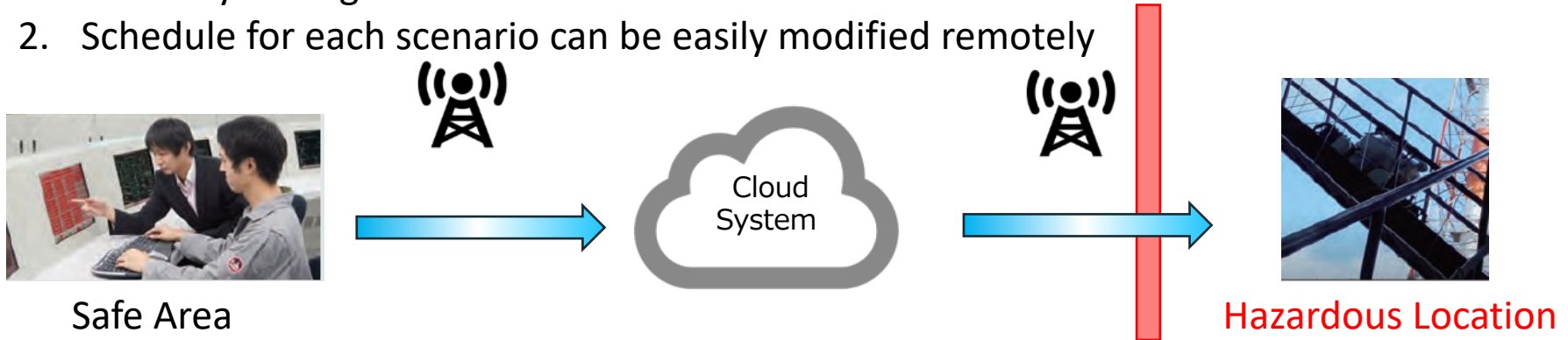
ROS Time: 1618536498.27 ROS Elapsed: 195.53 Wall Time: 1618536498.47 Wall Elapsed: 195.53

Reset

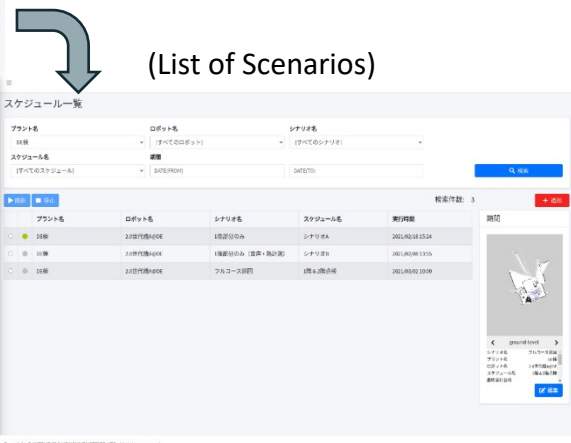
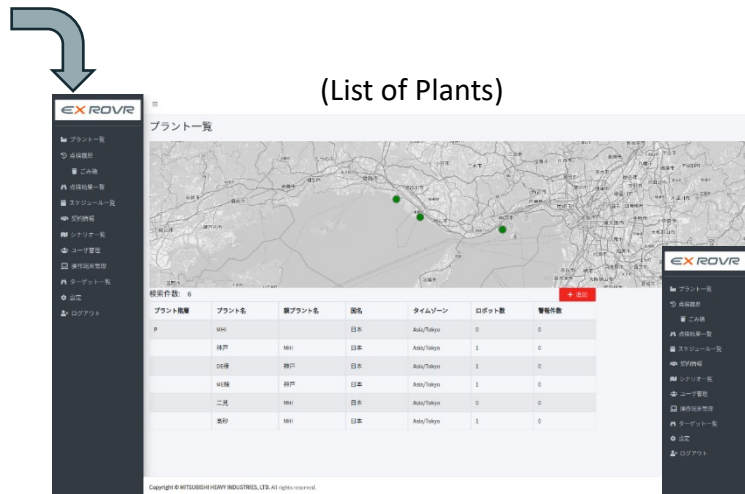
Experimental

4 fps

1. Uploaded plant information / scenario information can be reviewed and validated remotely through a secure connection via internet browser
2. Schedule for each scenario can be easily modified remotely

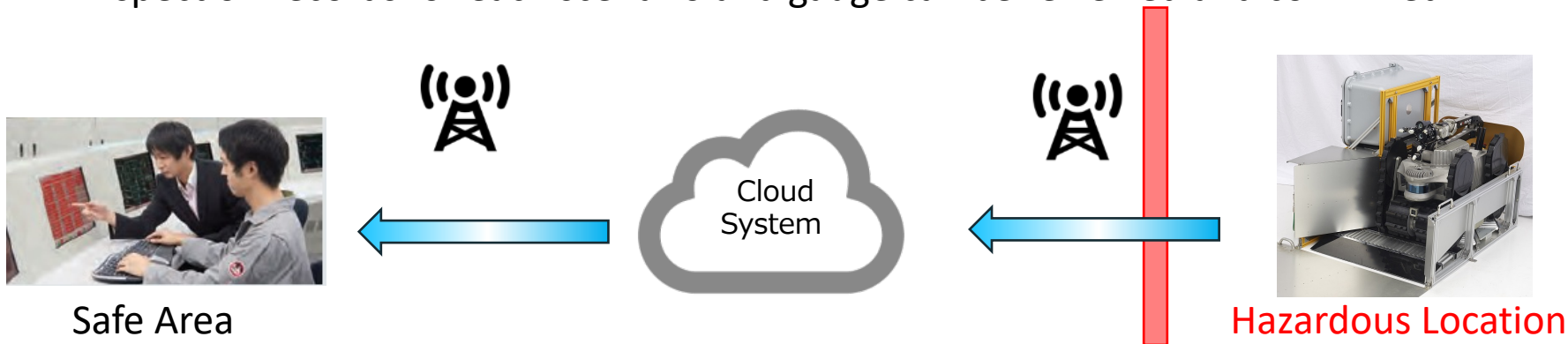


(Authentication)



# Monitoring Window to confirm history data

1. Uploaded inspection record is confirmed through a secure connection via internet browser
2. Inspection records for each scenario and gauge can be reviewed and confirmed



(Inspection records for each scenario)

シナリオ名	1階部分のみ	点検時間 (分)	0	異常件数	0/3
ターゲット名	時間	種別	異常	画像・音声	
1 1階パイプ1	2021/02/02 16:43	画像			
2 1階パイプ2	2021/02/02 16:43	画像			

(Historical data for each gauge)

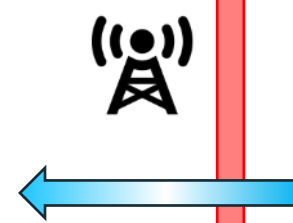
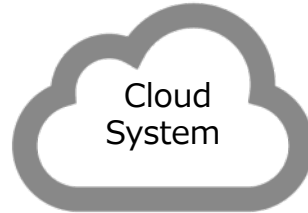
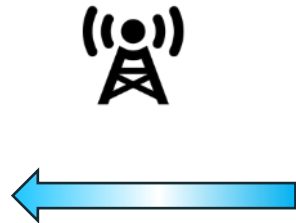
プラント名	ロボットID	シナリオ名	実行時間	データ種別	ターゲットID
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/19 11:28	画像	50
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/19 11:22	画像	52
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/19 11:22	画像	51
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/18 16:04	画像	50
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/18 16:04	画像	52
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/18 16:04	画像	51
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/18 16:03	画像	50
<input type="checkbox"/> DE棟	33	1階部分のみ	2021/02/18 15:46	画像	52



Real time inspection data and robot data can be confirmed through a secure connection via internet browser

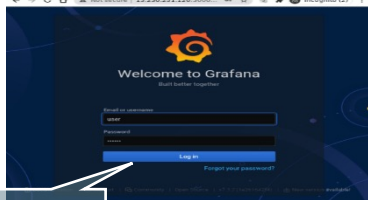


Safe Area

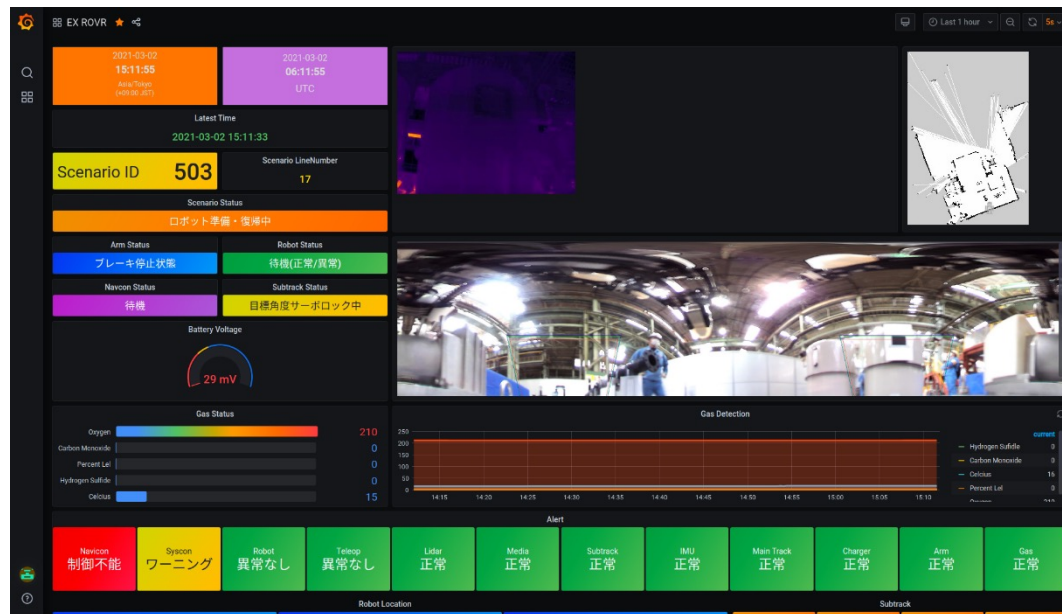


Hazardous Location

URL



Log In



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HEAVY  
INDUSTRIES  
GROUP**