Train for RP survey and visual inspection in LHC

RadWG meeting - 8th May 2013

CERN
EN Engineering Department
HE Group: Handling Engineering

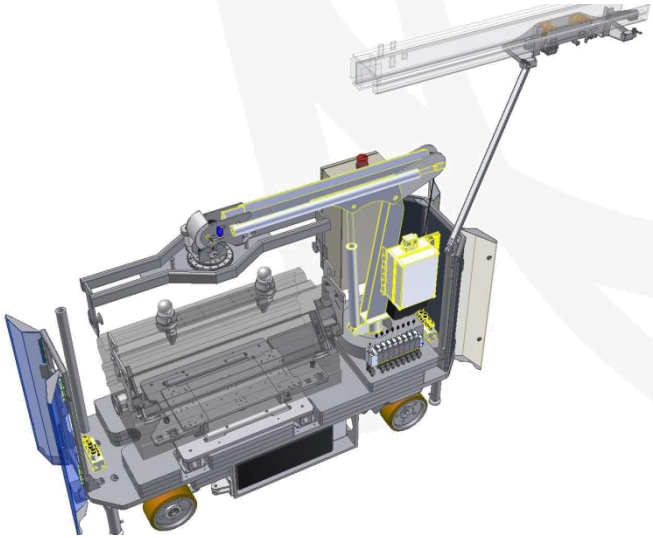
Bruno FERAL

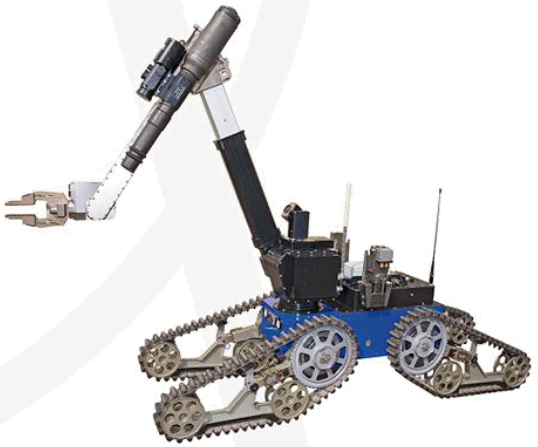
EDMS: **1284415**

Section EN-HE-HT

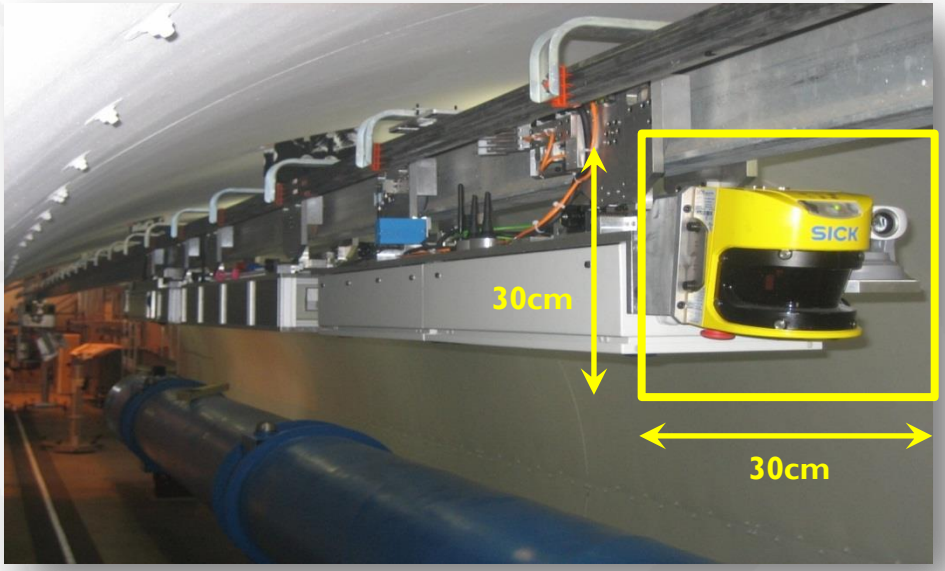
Our main task:

Design and development of remote handling equipment for interventions in radioactive areas at CERN.





The TIM* 30 x 30: a remote controlled inspection vehicle for LHC tunnel :



- Radiation + oxygen measurements
- Visual Inspection with cameras (HD, infrared, etc)
- Autonomous: Battery powered
- Additional payload on demand

*TIM: Train Inspection Monorail

Outline

- Mission of TIM series
- TIM main characteristics
- TIM tests in LHC early 2013
- TIM components

Development of TIM pre-series and series

Mission:

To provide remote inspections, radiological surveys in the entire LHC tunnel when the machine is not in access mode.

Establish a reliable service that is fully automated and fully integrated in the LHC operational procedures and controls software and contributes to the full exploitation of the physics potential of the LHC.

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TIM 30-30: main characteristics

- **Visual Inspection**
- *Radiation + oxygen measurements*
- *Parks in P5 by-pass*
- *Pass from P5 - P2 and from P5 - P8*
- *Max speed 8km/h*
- *Control from CERN Control Centre*

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TIM 30-30: main characteristics

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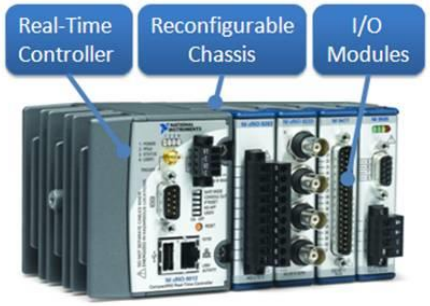
RP Data transmission system

RP wagon

NI Compact RIO



ETIC 3G Modem

Ethernet

PCMX sensor
«Dose rate value»

ETIC 3G Modem

Ethernet

Laptop reception data

TIM 30-30: main characteristics

- *Visual Inspection*
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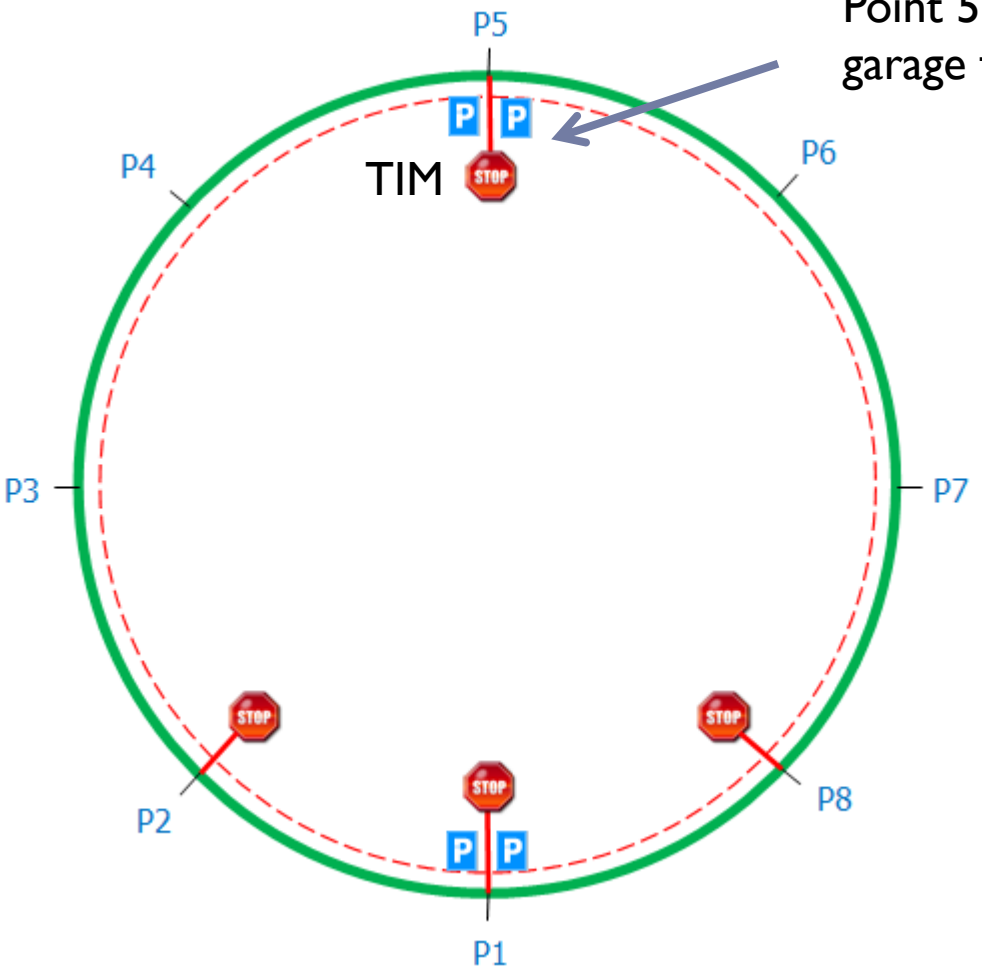
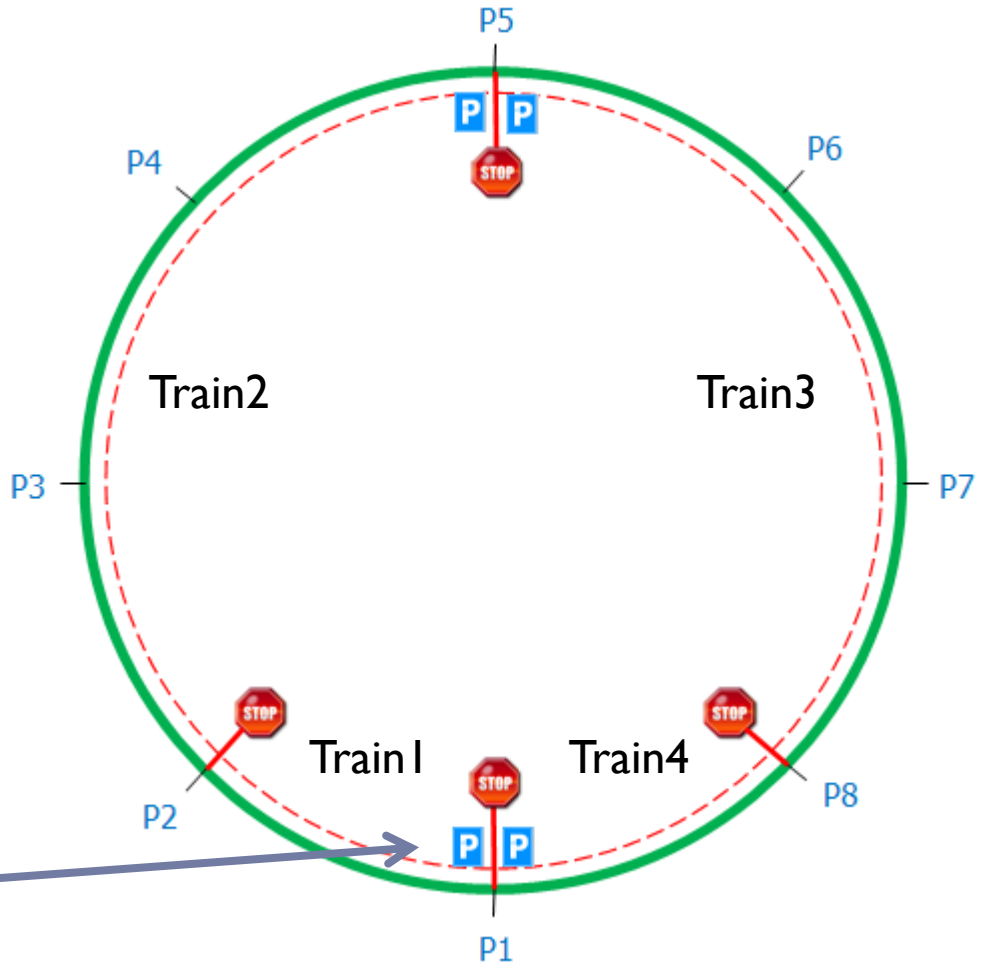
Current situation: 1 train & 1 garage



Point 5 by pass is a natural garage for TIM.

Proposal: 4 trains & 4 garages:



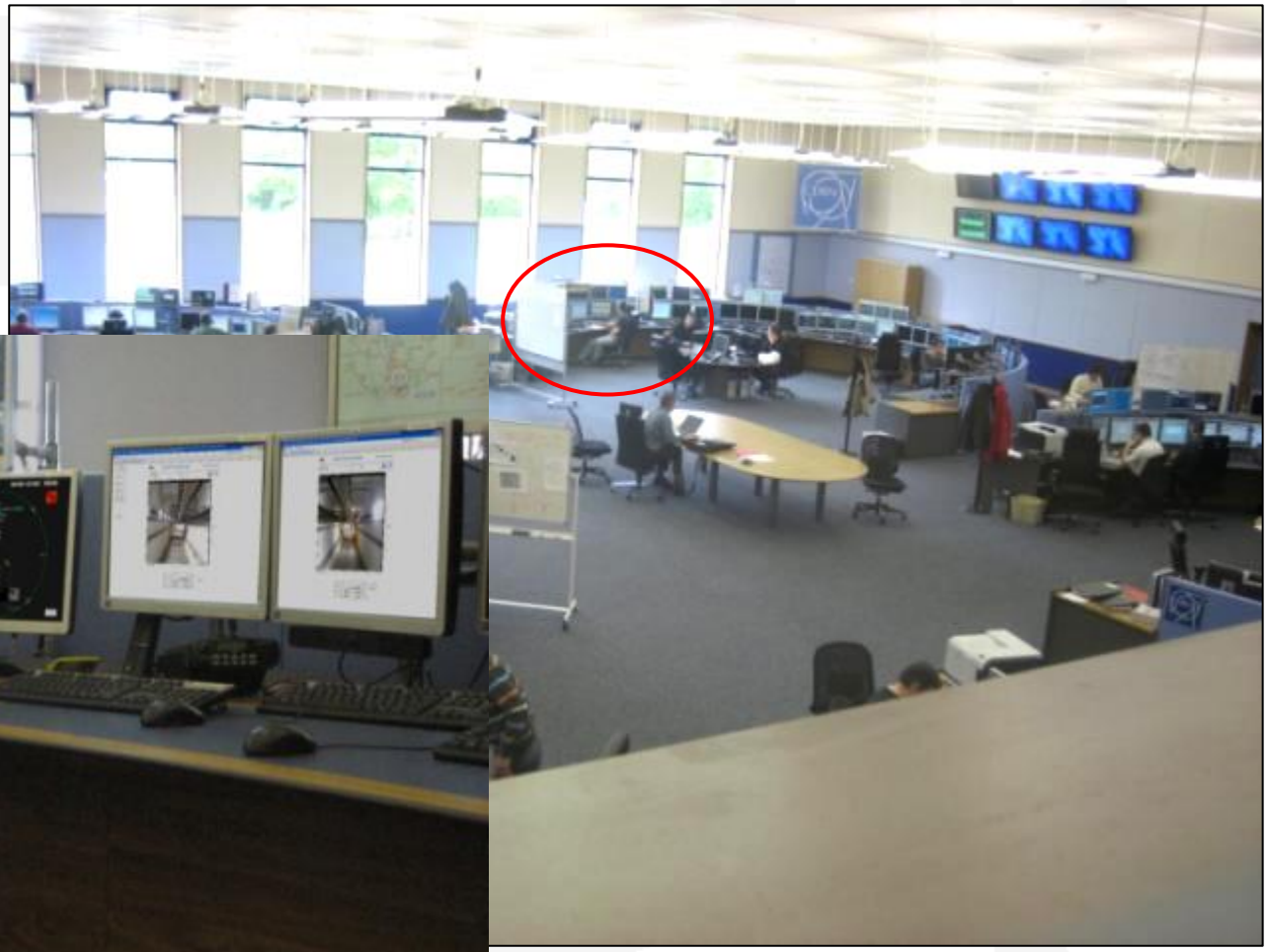
2 new garages shall be built
on each side of point 1.

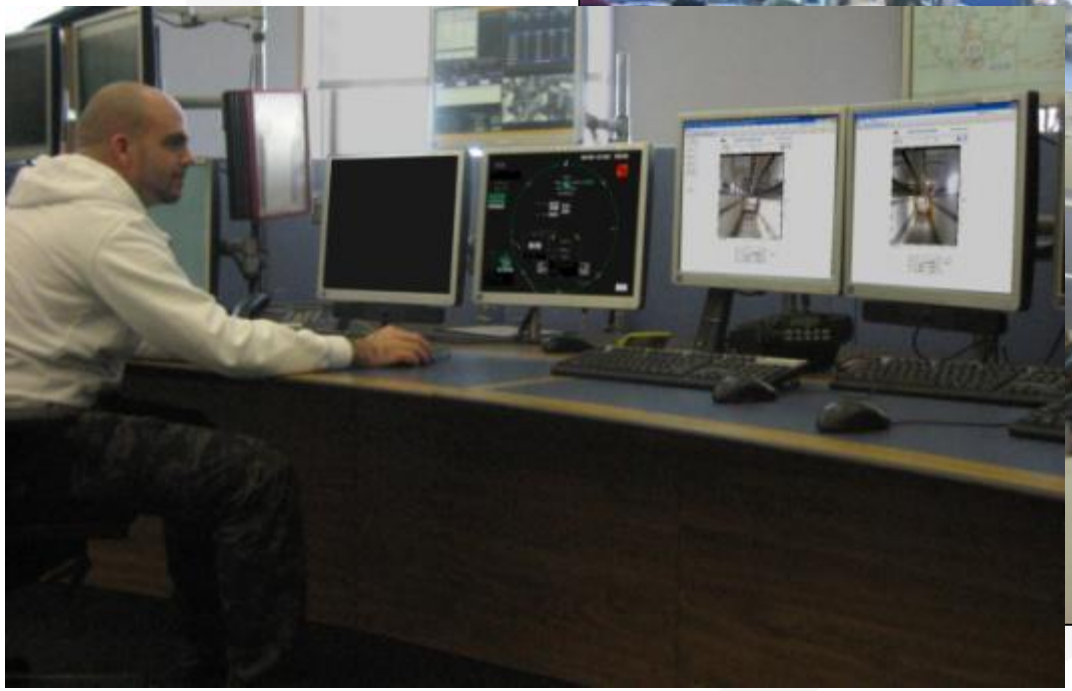
It shall be possible to dismantle them during technical stop or shutdown.

TIM 30-30: main characteristics

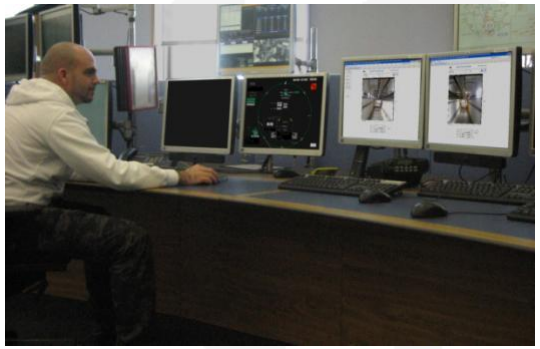
- *Visual Inspection*
- *Radiation + oxygen measurements*
- *Parks in P5 by-pass*
- *Pass from P5 - P2 and from P5 - P8*
- *Max speed 8km/h*
- **Control from CERN Control Centre**

TIM 30-30 CCC operation





Communication network



(CCC/CCR)

Modem

Sunrise network

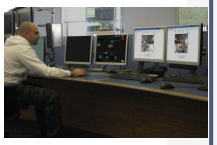
Surface

Tunnel LHC

Leaky feeder cable installed in the LHC tunnel – Sunrise network

TIM 30 x 30

Modem



PC control

PC vision

PC acquisition
données Radiation

PLC Siemens
control

1

VPN to 4

IPL-3G

réseau Sunrise

Vers modems 3 et 6

Internet

2

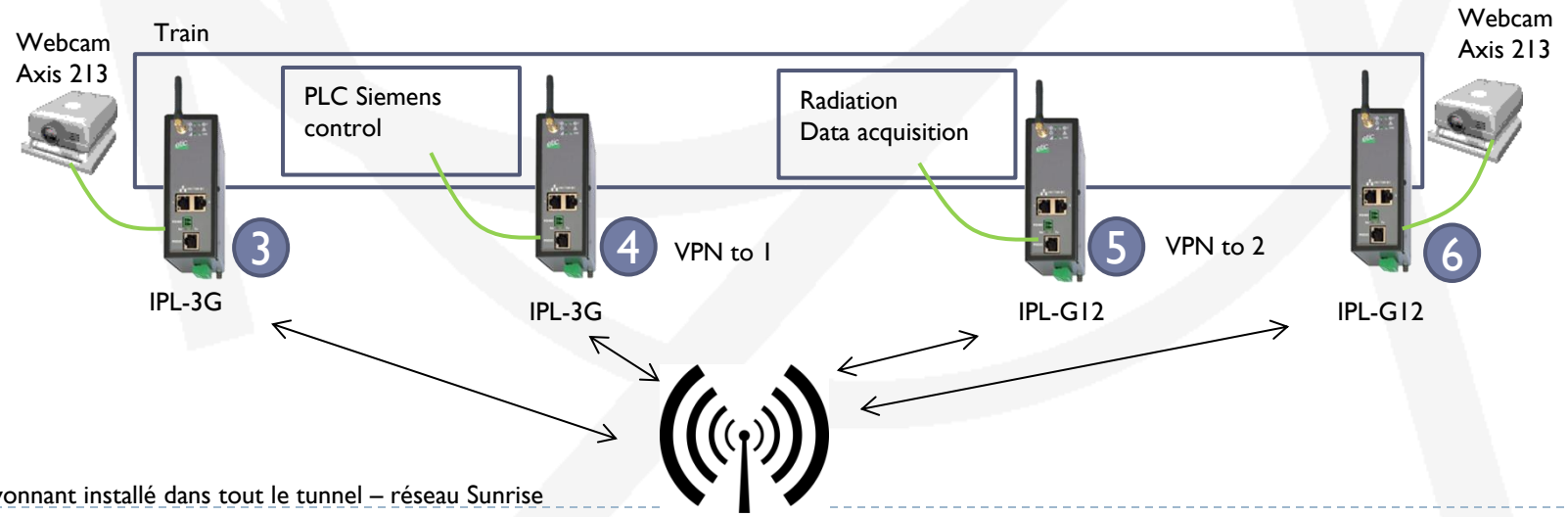
VPN to 5

IPL-G12

réseau Sunrise

Surface (CCC/CCR)

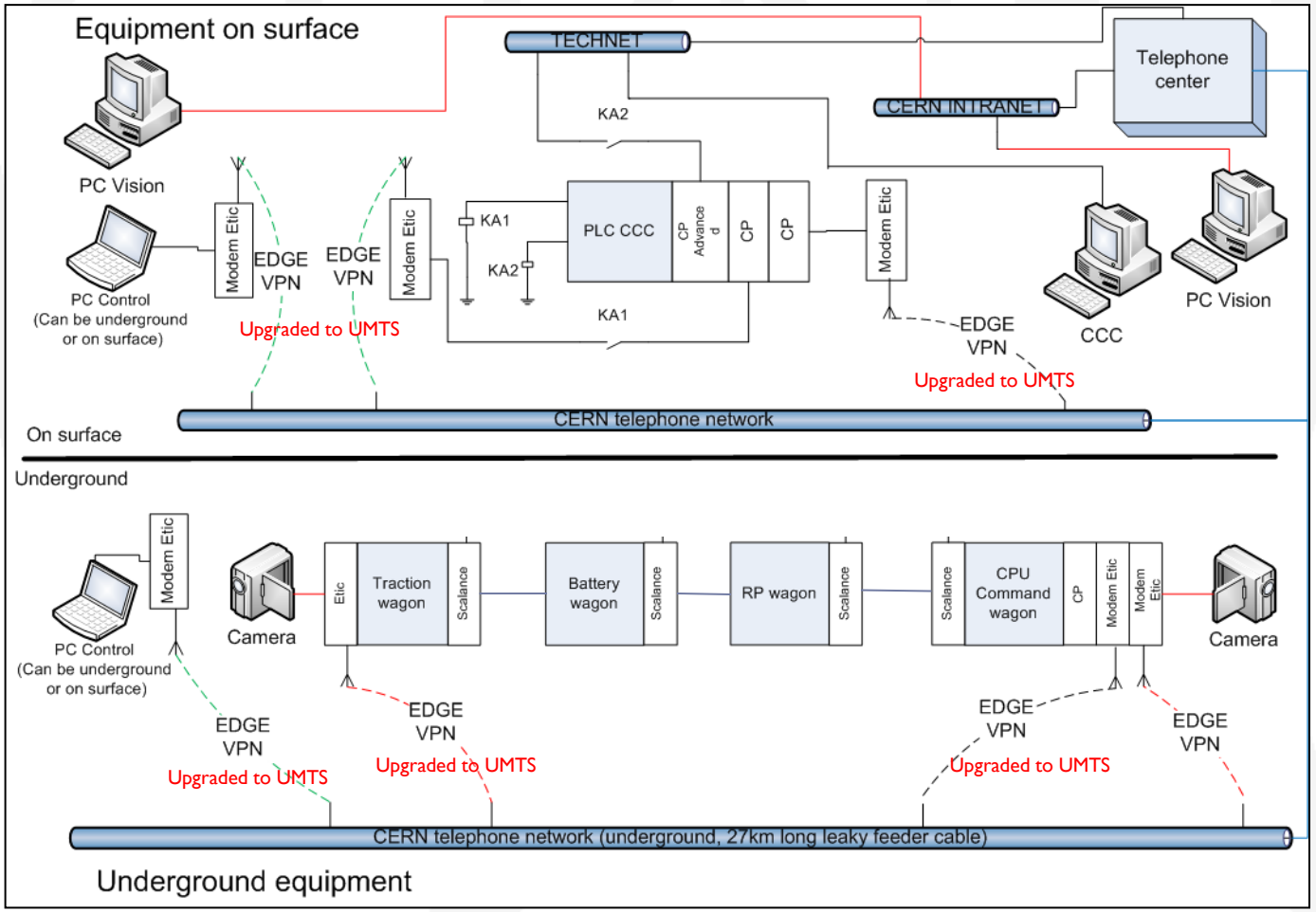
Tunnel LHC



Cable rayonnant installé dans tout le tunnel – réseau Sunrise

Communication Network in more details

TIM control: phone & computer network



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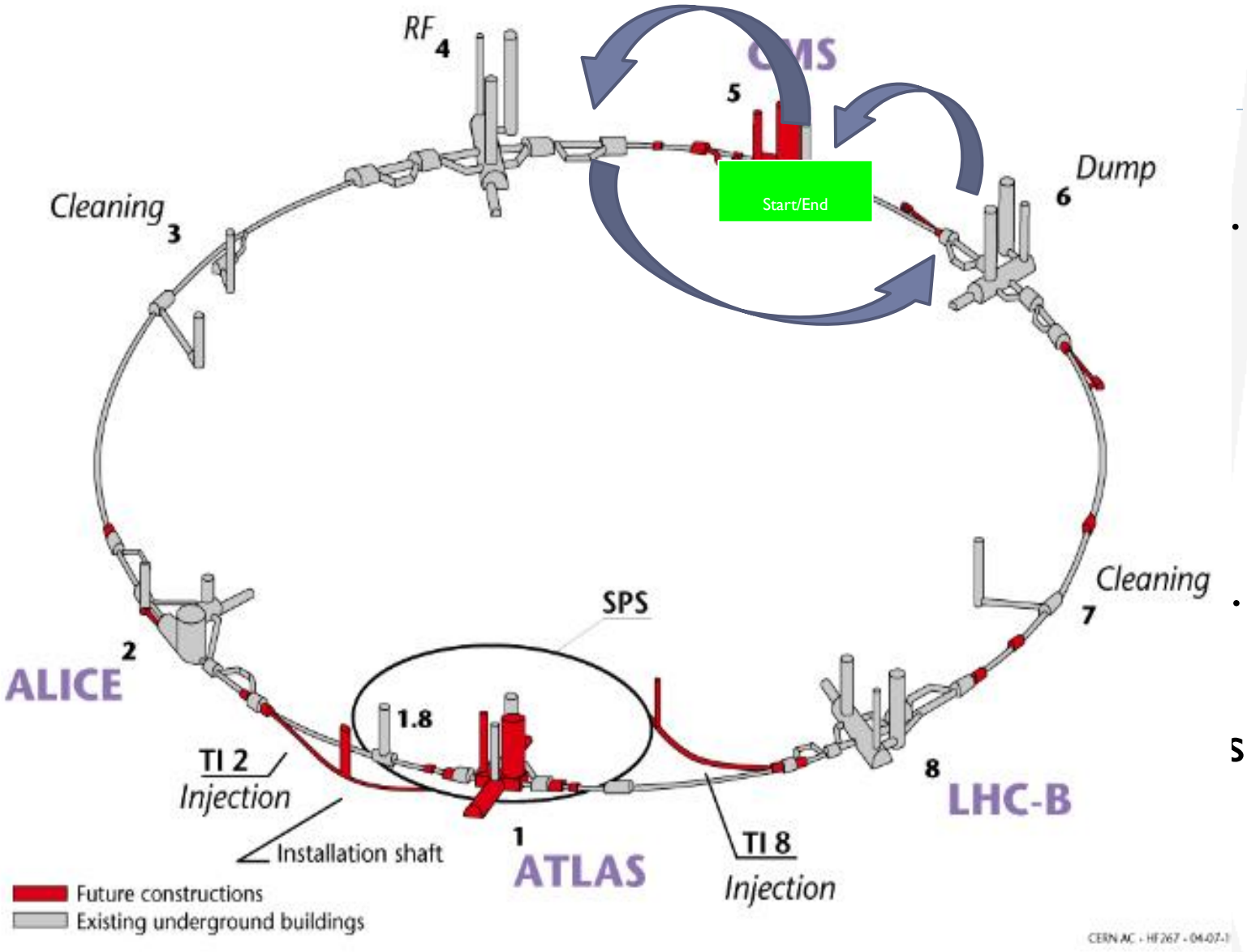
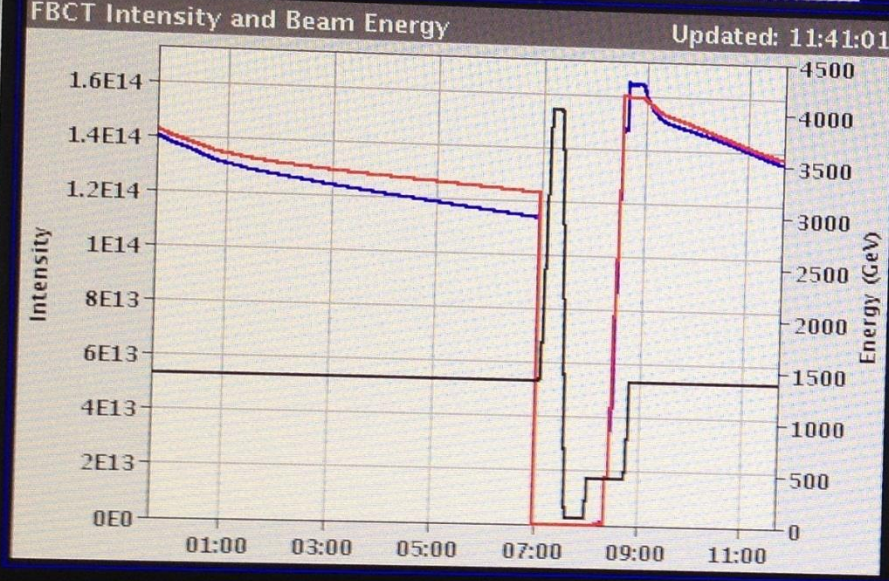

RF
4
CMS
5
Start/End
Dump
6
Cleaning
3
Cleaning
7
SPS
ALICE
2
1.8
TI 2
Injection
Installation shaft
1
ATLAS
TI 8
Injection
8
LHC-B
Future constructions
Existing underground buildings
CERN AC - HF267 - 04-07-1

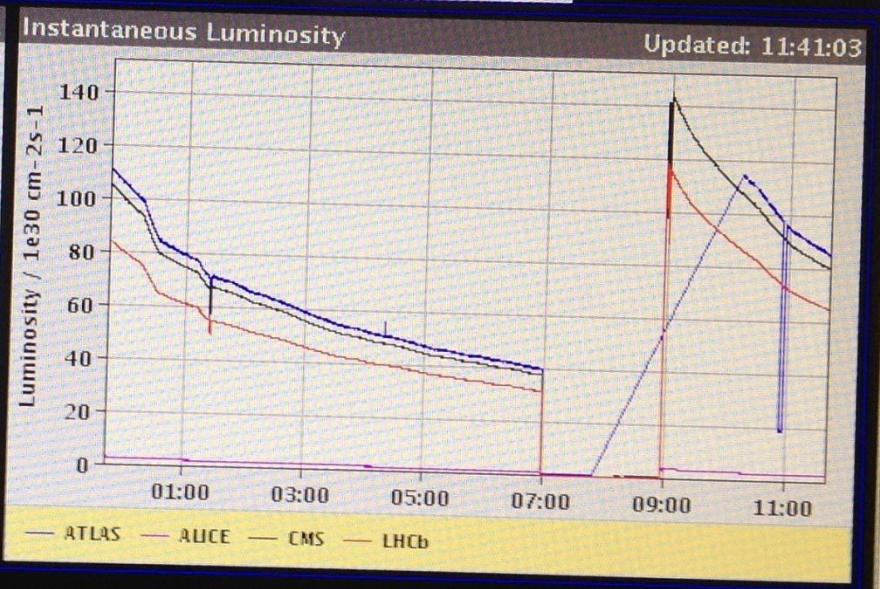

UPSTREAM
10.2.157.196
DOWNSTREAM
TIM
standby
target
survey
home
reconnaissance
Start
Stop
0.5 km/h
12378.32
R51
LHC Page1
Fill: 3560
E: 1380 GeV
PROTON PHYSICS: STABLE BEAMS
Energy:
1380 GeV
N(B1):
1.43e+14
N(B2):
1.44e+14
NEXT: physics fill
VIDEO SURVEILLANCE

LHC Page1 | Fill: 3560 | E: 1380 GeV | t(SB): 02:39:33 | 13-02-13 11:41:03

PROTON PHYSICS: STABLE BEAMS

Energy:	1380 GeV	I(B1):	1.35e+14	I(B2):	1.37e+14





Comments (13-Feb-2013 11:26:56)

Starting length scale calibration in IP1

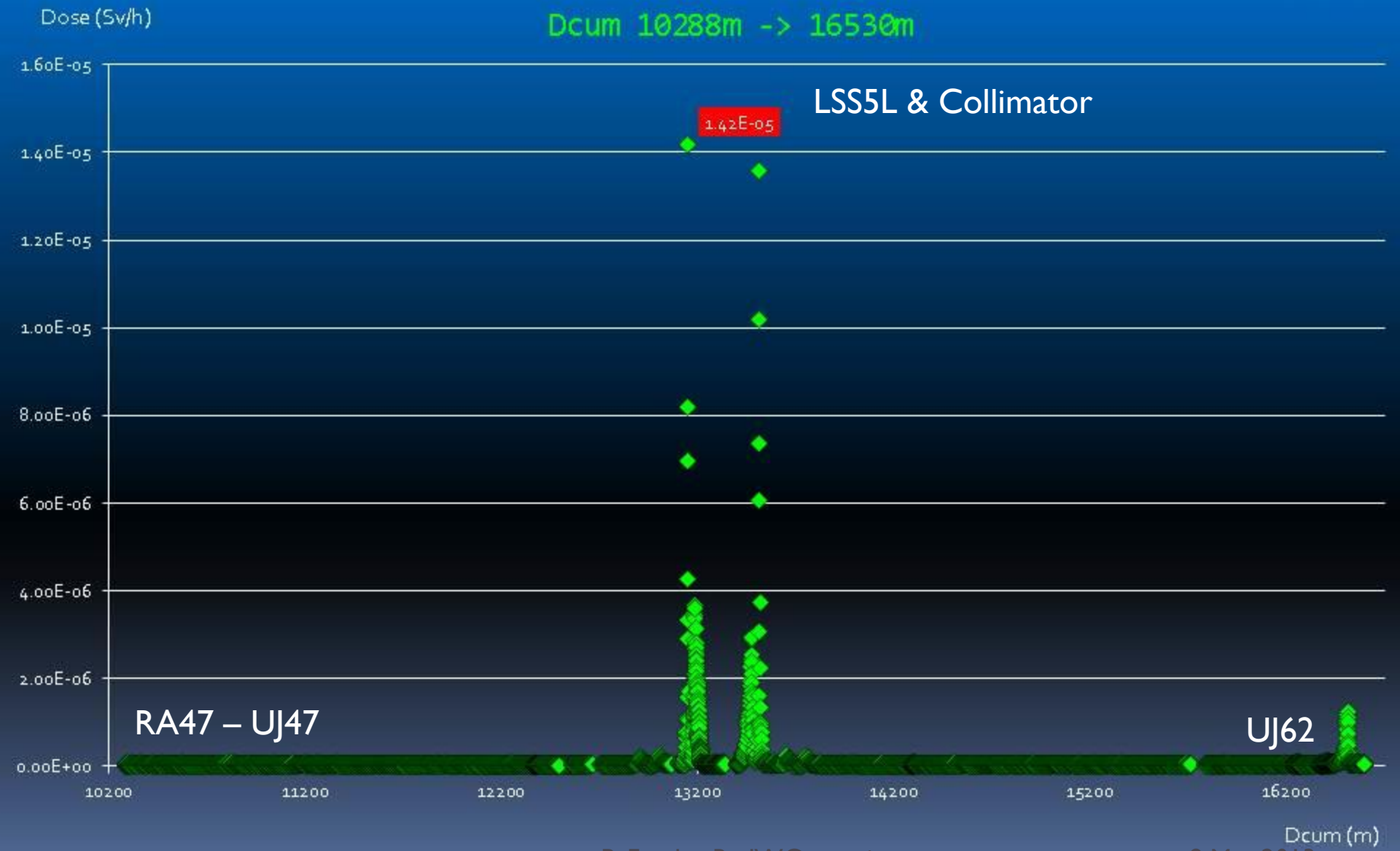
NEXT: Fill for VdM scan

BIS status and SMP flags	B1	B2
Link Status of Beam Permits	true	true
Global Beam Permit	true	true
Setup Beam	false	false
Beam Presence	true	true
Moveable Devices Allowed In	true	true
Stable Beams	true	true

AFS: 50ns_1374b_1278_36_1218_144bpi12inj

PM Status B1: ENABLED | PM Status B2: ENABLED

09/01/2013 Survey



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TIM components

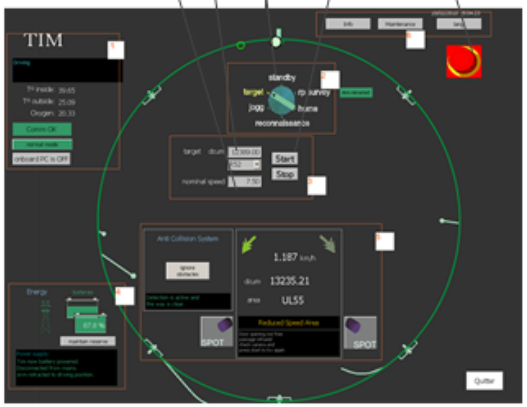
Motor wagon | Reconnaissance wagon | RP wagon | Battery wagon | Control wagon

8.84 meters

1.36 meters

Bar code reader position

10.2 meters



Old HMI view

CCC

HMI

speed

destination

Start/stop buttons

Emergency stop

mode

CCR

VPN

UMTS 900

Laser scanner, Collision system scanners

DI

Barcode reader

RS232

Status, several components

DI

TIM

Distance laser

AI

Drive of power connection

DO

Earthing connection

DO

X,Y position (Drive sensor)

D I/O

Light

Speed set (AO)

Main motor

encoder

Analog 4-20mA

Analog 4-20mA

Position info RS232

Emergency stop

I

U

Battery

Pos. info

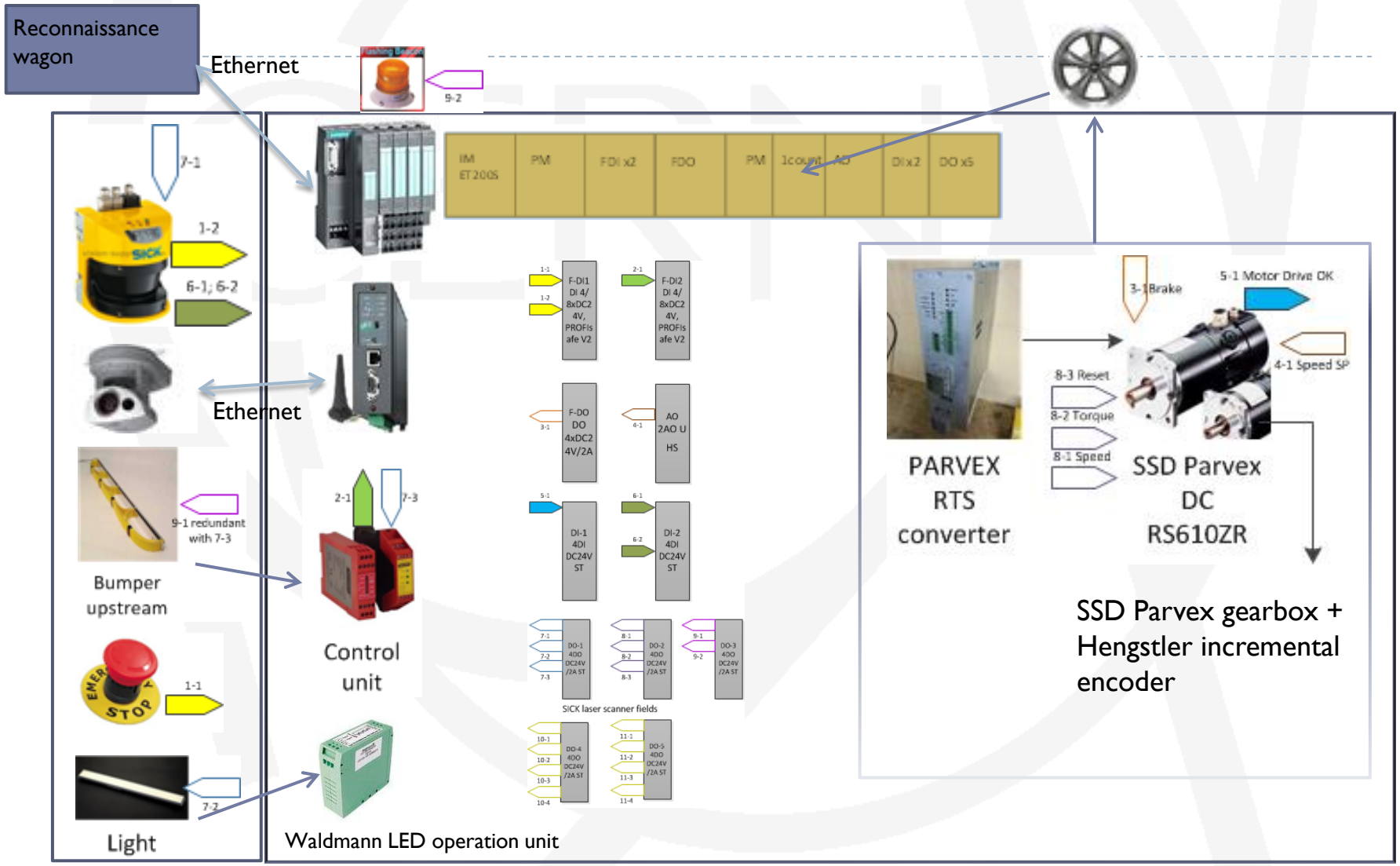
PLC

RP computer

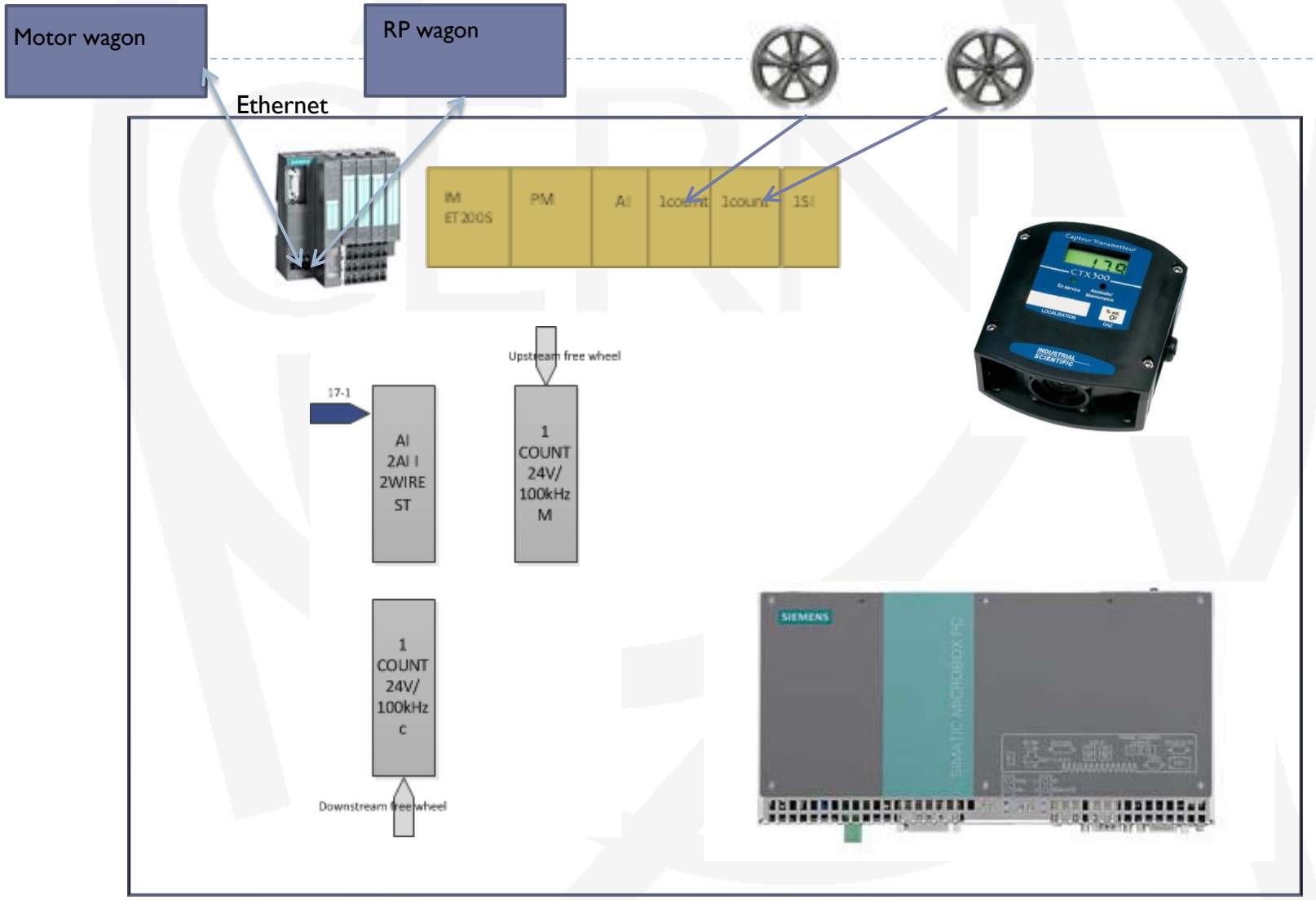
MODES:
Target
RP survey
Jog mode
Visual inspection
Stand-by

VISUALIZATION:
RP data histogram (later stage)
Camera view
Battery charge level
Real position in the tunnel
Direction of moving
Electromechanical data (torque, acceleration, ,...)
Feedback messages
System status
RP arm status

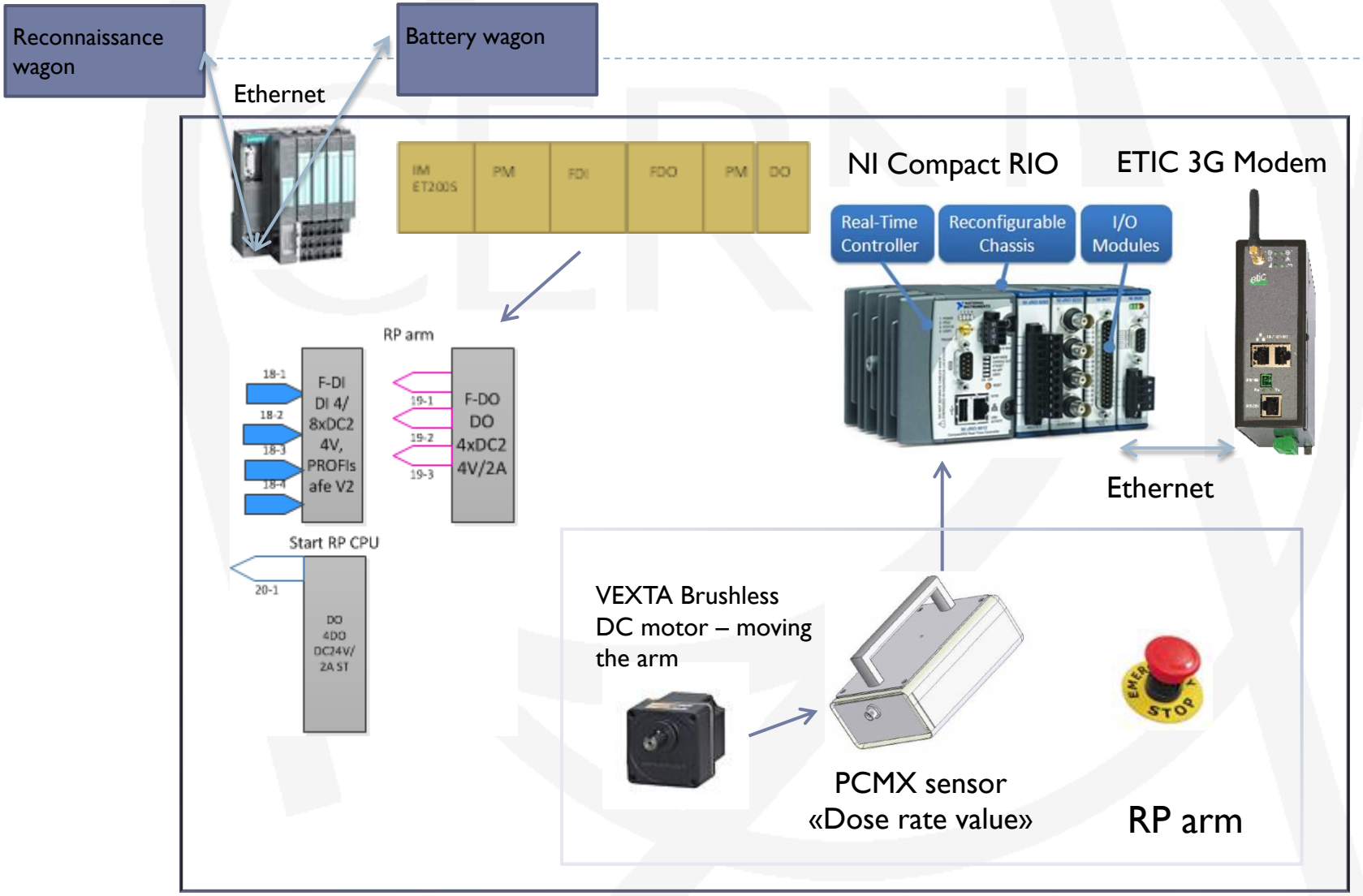
Motor Wagon


Reconnaissance wagon
Ethernet
9-2
7-1
1-2
6-1; 6-2
Ethernet
9-1 redundant with 7-3
Bumper upstream
1-1
7-2
Light
2-1
7-3
Control unit
IM ET200S
PM
FDI x2
FDO
PM
1count
AO
DI x2
DO x5
F-DI1 DI 4/ 8xDC2 4V, PROFIsafe V2
F-DI2 DI 4/ 8xDC2 4V, PROFIsafe V2
F-DO DO 4xDC2 4V/2A
AO 2AO U HS
DI-1 4DI DC24V ST
DI-2 4DI DC24V ST
DO-1 4DO DC24V /2A ST
DO-2 4DO DC24V /2A ST
DO-3 4DO DC24V /2A ST
SICK laser scanner fields
DO-4 4DO DC24V /2A ST
DO-5 4DO DC24V /2A ST
Waldmann LED operation unit
PARVEX RTS converter
3-1 Brake
5-1 Motor Drive OK
4-1 Speed SP
8-3 Reset
8-2 Torque
8-1 Speed
SSD Parvex DC RS610ZR
SSD Parvex gearbox + Hengstler incremental encoder

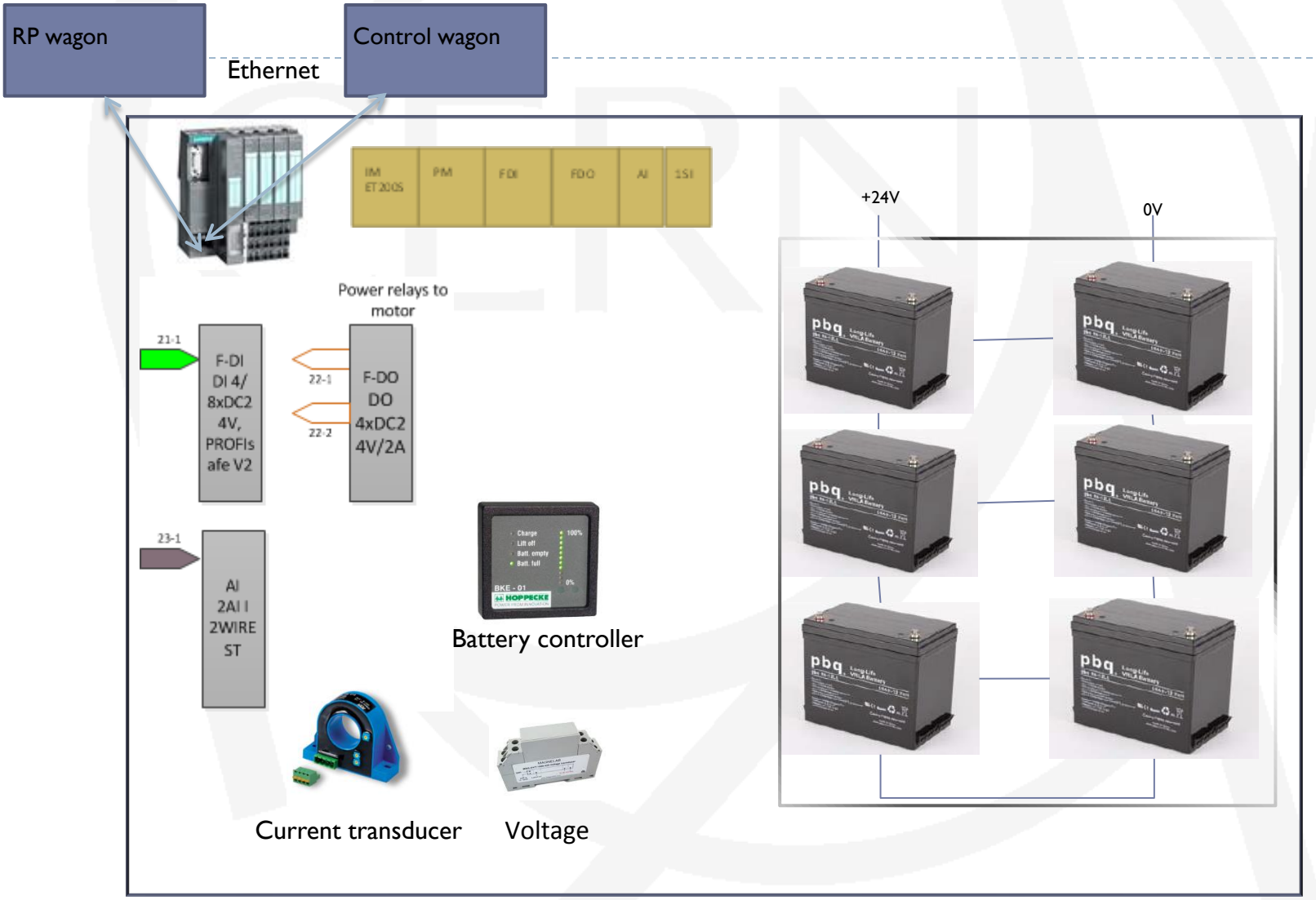
Reconnaissance Wagon



RP Wagon


Reconnaissance wagon
Battery wagon
Ethernet
IM ET200S
PM
FDI
FDO
PM
DO
NI Compact RIO
ETIC 3G Modem
Real-Time Controller
Reconfigurable Chassis
I/O Modules
Ethernet
RP arm
18-1
18-2
18-3
18-4
F-DI DI 4/ 8xDC2 4V, PROFIsafe V2
19-1
19-2
19-3
F-DO DO 4xDC2 4V/2A
Start RP CPU
20-1
DO 4DO DC24V/ 2A ST
VEXTA Brushless DC motor – moving the arm
PCMX sensor «Dose rate value»
RP arm

Battery Wagon



Control Wagon