Maintenance of infrastructures equipments, and control system electronics at ALBA Synchrotron

Computing Division

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CELLS – Computing Division
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Operation Meeting

Some members of **Management** & **Safety** are present in the meeting.

- **Accelerator**
  - RF Section
  - Magnet Section
  - Diagnostic
  - Insertion Devices
  - Coordinator

- **Computing**
  - Control
  - Electronics
  - MIS
  - System
  - Coordinator

- **Engineering**
  - Infrastructures
  - Mechanical
  - Vacuum
  - Coordinator

- **Experiments**
  - Beam Lines
  - Coordinator

Accelerator Meetings
Computing Meetings
Engineering Meetings
Experiment Meetings
### Tickets

- **Specific Task t<200h**
  - No limit
- **Now around #37000**

### Services

- **30 currently defined**
  - **Preventive Maintenance**
    - PCB Boards production
    - Electronics lab pool
    - Electronics design support
    - Instrumentation support
    - Electronics purchasing
    - BL technician support
  - Combined with 30 units
    - Accelerators
    - BL04
    - Computing
    - Optic Lab
    - Radio frequency
    - Vacuum

### Projects

- **Specific Task t>200h**
  - No limit
  - **Now around 40 active**

### Others

- **Training**
- **Meeting**
- **Innovation**
- **Administrative**
INTERNAL ORGANIZATION of Computing SECTION (Tasks)

HEAD of the Section

Projects. Maintenance Plan, EM, FOFB,… (t> 200h)

Tickets & Services for Support, and new or change installations

* Mini-Projects Tickets (20h< t <200h)

Engineers Tickets (t<20h)

* Technician Tickets (t<20h)

FRAMEWORK: MACHINE, BEAM LINES AND BUILDING INFRASTRUCTURES & FACILITIES
Set of **GENERAL & SPECIFICS** procedures (at least in a Flow Chart) for the matters as follow:

- Personal Safety during the Development of a Task
- Preventive & Corrective Maintenance Tasks (Predictive in the next future)
- Measurement of Parameters
- Cabling & Equipments Installation (equipments, cables, connectors & trays)
- CCDB Update
- User Guides & Manuals
UPDATING A NEW CONNECTOR or a CABLE TYPE IN THE CCDB

Proposer Engineer A introduces information of connector and/or cable in the Cab_Con v10.xls at AllDivisions/ALBA Equipments-Cables database/ALBA Cable Configurations.

Proposer Engineer creates a RT Ticket in the electronics queue for the Engineer Reviewer.

Engineer Reviewer checks Revision and/or Modification Information OK.

- No: Modify Ticket in electronics queue and Request Modification.
- Yes: Engineer Reviewer updates CCDB with information included in Cab_Con v10 using SQL Editor. (In the future a MIS Application Sub-Menu: will be available)) and he resolves the ticket.

Engineer Proposer checks that everything is right.

- No: Engineer Proposer modifies ticket in electronics queue and requests modification.
- Yes: Engineer Proposer resolves ticket and closes it.

INTERNAL ORGANIZATION of Computing Division (Procedures)
INTERNAL ORGANIZATION of Computing Division
(Sections)

HEAD of the Section

- Projects (FOFB, EM, Maintenance Plan, ... > 200h)
- Tickets for Beam Line’s User Support, and new or change installations
  * Mini-Projects Tickets (20h < t < 200h)
  * Engineers Tickets (t < 20h)
  * Technician Tickets (t < 20h)
- Services
- Others

FRAMEWORK: MACHINE, BEAM LINES AND BUILDING INFRASTRUCTURES & FACILITIES

SOFTWARE TOOLS

Prince2
CCDB for Cabling & Equipments MIS App
RT Ticket App
Time DB MIS App
Others MIS App
Technical Software

Pre-Project Initiation Stage
Final Stage

Cabling Reports
Cabling Templates
Equipment Report
Equipment Template
Equipment Documentation
Rack report
Automatic EPS code generation
Automatic Network configuration
Automatic Control code generation
Tango devices and attribute names
Logs for Traceability of Equipments & Cabling
Stock Control

Description, status, times & classification
Dates
People Involved communication
Link with others tickets
Comments & Doc. attached

Tickets (auto) Services Projects Orders
Safety Tickets & Trainings Manipulation & Internal Orders e-purchasing Overtime & Absences Tunnel and SA access request Meeting-Room Booking

Altiun
PSpice
Siemens NX
MatLab

Engineers
Technicians
SOFTWARE TOOLS
(Management, Coordination, Organization & Control)

* Mini-Projects, (20h < t < 200h)

Request Tracker
(Ticket Support System)

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**Mini-Project_Initialize:**

- Senior User:
- Senior Supplier:
- Project Assurance:
- Explicit customer request:
- Expected benefit:
- Forecasted tasks:
- Estimated Cost:

**History:**

- Wed Oct 23 18:38:43 2013: acamps - Ticket created

Download (untitled) / with headers

**text/html 2.5k**
SOFTWARE TOOLS
(Management, Coordination, Organization & Control)

Tickets (t <20h)

• Engineers
• Technicians

Request Tracker
(Ticket Support System)
• Equipments, connectors and cable types
• Instances of equipments and cables (naming conventions)
• Documentation files
• Installation logs
• Source for automatic code generation and creation of Tango devices
Computing division
ALBA Cable Pin-out Definition Document

SMW6-10
CABLE PINOUT CONFIGURATION INFORMATION

This cable configuration consists of one Binder circular male plug connected with a square female connector using a multi-wire 6x0.34 mm² LIYCY cable.

It is used to connect:
1. Sense input of Pfeiffer TGP261 Vacuum controller with Sense output of PRH201 Full Range Vacuum Gauge.

<table>
<thead>
<tr>
<th>TERMINAL POINT A</th>
<th>TERMINAL POINT B</th>
<th>CABLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRC06940</td>
<td>SQ006F9</td>
<td>MW06015</td>
</tr>
</tbody>
</table>

1 (0) 1 (0) 1 (0)

2 (Supply Common, GND) 5 (Supply Common) Grey
3 (Signal Input) 2 (Signal Output) Brown
4 (Signal Common) 3 (Signal Common) Green
5 (Screening) 6 (Screening) Pink
6 (Supply, +24VDC) 4 (Supply) Yellow

SHELL 6 (Screening) SHEILD

MANUFACTURING INFORMATION

The wire-to-contact connections must be done using a suited crimping tool. Where it is not possible to use crimped contacts due to the special connection pattern, soldered contacts may be allowed, but the solder must be protected with thermo-shrink insulation.

The shielding braid must be grouped forming a pigtail. The pigtail must be pressed between the connector shell and the cable hose to assure a good electrical contact. When the shielding pigtail has to be connected to any connector pin, the pigtail will be also protected with thermo-shrink insulation.

The cable must have several visible labels according to the ALBA cable label specification.

NOTE: This cable can be found commercially at Pfeiffer Vacuum with reference PTF440260-T (in this example the length is 3m, for other lengths other references can be found.)
But CCDB is not only being used as a static repository:

Automatic Network configuration

Automatic Control code generation Tango device and attribute name
**SOFTWARE TOOLS**

CCDB for Cabling & Equipments: **Automatic Code generation**

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**Automatic Equipment Protection System code generation (PLC)**

- **XLS files**
- PLC documentation: I/F with devices, I/O channels assignation, etc.
- PLC code generation:
  - PLC variables declaration
  - PLC Mod-bus mapping and variables allocation.
- PLC standard services: disable and force variables, alarm/warning thresholds checking, permanent memory storage, etc.

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**Software Tools**

- MySQL
- ALBA CCDB
- AlbaPLC Device Server
- Modbus Device Server
- TANGO

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**XLS**

- VBasic script
Calculation of stock for spare parts

An estimation of the initial stock of cabling and equipments needed have been done using Poisson distribution:

\[ P = \sum_{n=0}^{s} \left[ \frac{(K\lambda t)^n e^{-K\lambda t}}{n!} \right] \]

- \( P \): Probability of failure (different values depending if a part is considered critical: obsolescence, uncertain delivery time,...)
- \( K \): Number of instances of each part
- \( t \): Estimated delivery time
- \( \lambda = 1/MTBF \)
- \( s \): Number of parts in stock

Once you have received the initial existence only need replenishment orders per year
Calculation of stock for spare parts

We have to decide a % criteria for probability of non critical failures (not run out of stock) in a year (for instance 90%) and apply Poisson distribution formula

An example
### Calculation of stock for spare parts

#### Number of parts installed

<table>
<thead>
<tr>
<th>(k) Number of parts installed</th>
<th>32</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>(DT) Delivery time (days)</th>
<th>90</th>
</tr>
</thead>
</table>

| MTBF (years)                 | 3  |

| 1 Failure Probability / 1 day 1 part / (MTBF*365) | 0.091% |

\[
k \times \lambda \times t = \frac{k \times DT}{MTBF \times 365}
\]

\[
(k \times \lambda \times t \text{ pot (n)} \times \exp\left(-\frac{\lambda}{k}!\right) / n!
\]

Function value

Probability of no critical failures with k spares (no more than k parts will fail)

<table>
<thead>
<tr>
<th>Criteria: Prob. No Critical Failure in 1 year</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>90%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0</td>
<td>7.21E-02</td>
<td>7.21%</td>
</tr>
<tr>
<td>1</td>
<td>1.90E-01</td>
<td>26.16%</td>
</tr>
<tr>
<td>2</td>
<td>2.49E-01</td>
<td>51.09%</td>
</tr>
<tr>
<td>3</td>
<td>2.19E-01</td>
<td>72.94%</td>
</tr>
<tr>
<td>4</td>
<td>1.44E-01</td>
<td>87.31%</td>
</tr>
</tbody>
</table>

To be purchased

5 units

<table>
<thead>
<tr>
<th>Number of spares</th>
<th>Function Value</th>
<th>Prob. No Critical Failure in 1 year</th>
<th>Prob. Critical failure</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>7.56E-02</td>
<td>94.87%</td>
<td>5.13%</td>
</tr>
<tr>
<td>6</td>
<td>3.31E-02</td>
<td>98.19%</td>
<td>1.81%</td>
</tr>
<tr>
<td>7</td>
<td>1.24E-02</td>
<td>99.43%</td>
<td>0.57%</td>
</tr>
<tr>
<td>8</td>
<td>4.09E-03</td>
<td>99.84%</td>
<td>0.16%</td>
</tr>
<tr>
<td>9</td>
<td>1.20E-03</td>
<td>99.96%</td>
<td>0.04%</td>
</tr>
</tbody>
</table>
SOFTWARE TOOLS
(Management, Coordination, Organization & Control)

Projects, Tickets, Services & Others

Time DB App by MIS
(Ticket Support System)

Support
You can update RT tickets’ time spent addressing incidents, problems, user requests or requests for changes.

Services ★
You can input time spent attending any task needed for a service operation, for instance, maintenance, configuration, upgrade, etc. Any task someone asked you in Support.

Projects ★
You can input time spent on projects tasks, including project meetings and project management tasks. This data is also used to compute the real time spent on a project in CELLS Project Management application.

Others
You can input time spent on Coordination (mainly team meetings), Innovation (Investigation or Improvement on site requested), Management (Annual Interview, administrative tasks, informal discussions, etc), Training (courses, self-learning activities, coaching a colleague, etc.). Any time spent in project meeting should be assigned to the corresponding project.
Currently CCDB functionalities under development

- Traceability of each instantiated equipment (location)
- Traceability of each equipment S/N
- Traceability of each cabling ID (location)
- Chronological logs of all changes

Stock Manager applying Poisson Distribution & using Kanban Cards
(when a kanban card is received from storage area indicates that there is a depletion of a part which it will trigger the replenishment purchasing order to maintain the stock quantity calculated with the Poisson Distribution Formula)

- Exportable

It is being studied the best way to implement this functionalities linked with our current repository