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## **TCR REMOTE MONITORING FOR THE LHC TECHNICAL INFRASTRUCTURE**

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### **Abstract**

The remote monitoring of the LHC technical infrastructure will mainly be done in CERN's Technical Control Room (TCR). The technical infrastructure consists of specialised equipment from different groups and divisions, mainly cooling and ventilation and electrical equipment. The responsibility for the definition, operation and maintenance of the equipment is covered by the relevant equipment group. However the monitoring and alerting for action in case of equipment failure is initiated by the TCR and is based on alarms that are sent by the equipment. This implies the correct integration of the equipment and the establishment of rules to follow during the commissioning and start-up of the equipment in order to ensure proper operation. This paper shows the integration possibilities and the different tasks and steps to follow by the different parties for smooth equipment integration and avoiding organizational problems.

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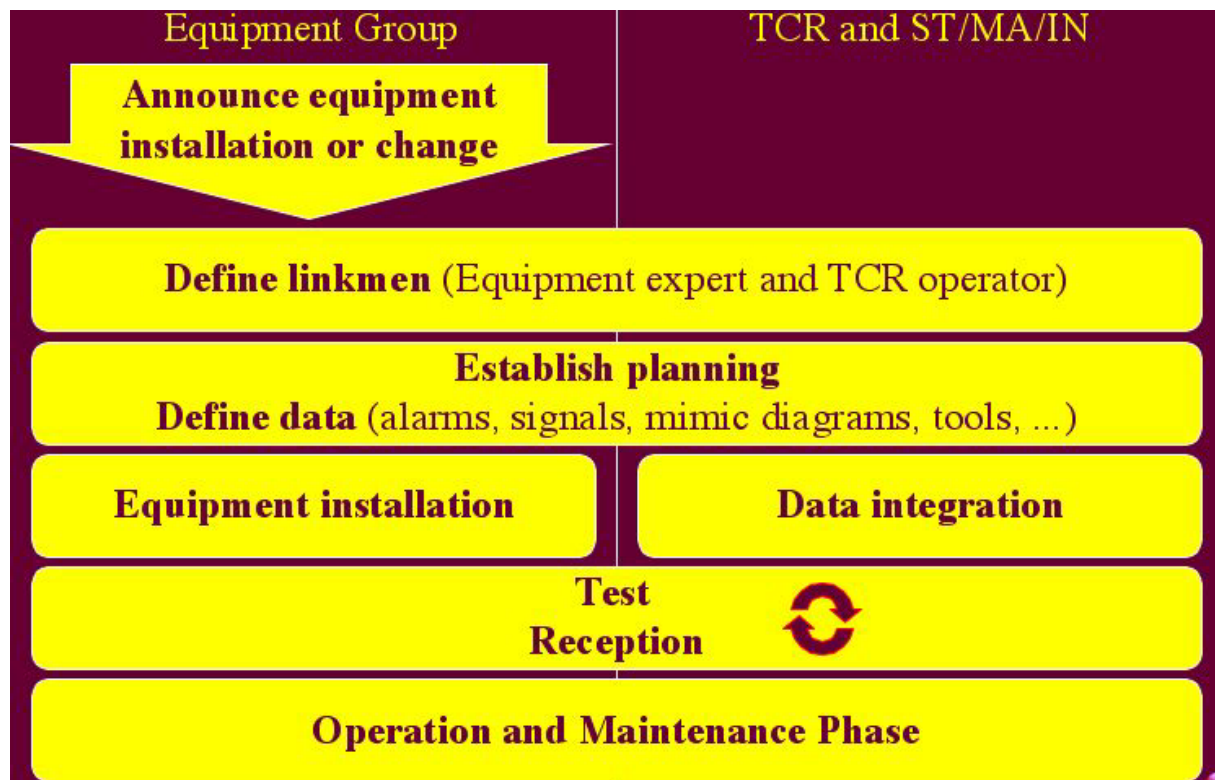
## 1 INTRODUCTION

The different technical services at CERN are currently installing the major part of equipment to assure the technical infrastructure for the LHC. It is clear that most of the equipment needs permanent monitoring to detect equipment failures immediately. Although the monitoring is a very important part, it is usually a very small percentage in the overall project, in terms of time and also in terms of money. In this sense it is very important to establish clear and easily understandable procedures and ways to integrate the different equipment in the Technical Control Room (TCR) environment with the optimal use of the existing resources.

## 2 PROCEDURE

In the year 2000 the so called "Technical Control Desk" (TCD) [1] and a corresponding procedure and web based tools were created in the TCR. This procedure defines the steps for the integration of different equipments and systems in the TCR environment. The procedure was since used more than 600 times and shows good results.

The integration process is started by requesting the integration via the TCD webpage. The TCR operator in charge will contact the requestor to discuss the integration details, to define linkmen on both sides and to establish the integration planning. The next step is the data definition and the choice of the integration technology and the corresponding interfaces. After the equipment installation and the preparation of the data transmission a common reception test will qualify the installation for the change into operation mode.



### 3 PROJECT ORGANIZATION

Different groups from all over CERN, but mainly ST division, request the monitoring of their equipment by the TCR. The monitoring is done by integrating alarm states and analog signals, like measurements, in the TCR environment and define instructions on how to react on incoming alarms. As the TCR integration is usually only a small part of the complete project, the project leader often nominates a technical expert for the TCR integration issues. Usually the technical expert is also the group linkman for discussions with the ST/MA linkman (mostly TCR operator) or the ST/MA technical expert. If more than one project from one group are integrated simultaneously, it is desirable that a group linkman is defined in order to ease the intra-group communication.

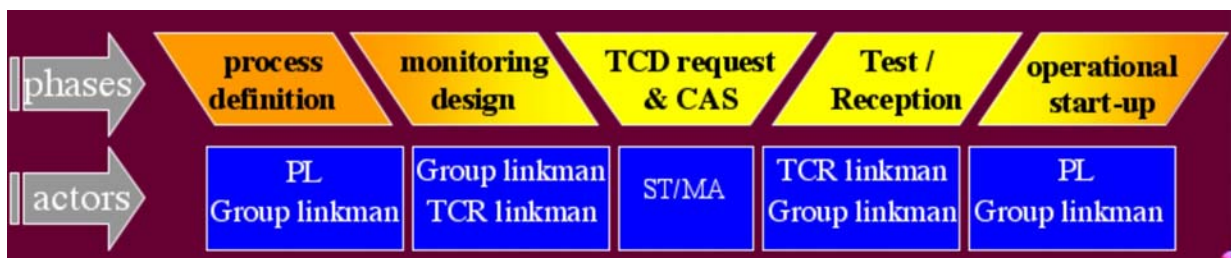


Even if the global approach is common to all integration projects, there are a lot of differences when comparing the different groups. The following table shows some examples of the different project organizations:

	ST/EL	ST/CV	ST/MA/AS	Others (Vacuum, Access Control, ...)
<b>Linkmen</b>	one linkman (EL and TCR) for all problems	One linkman per project	One linkman	one linkman per group
<b>Interfaces</b>	single data exchange interface (GATEX), one contractor	2 data exchange interfaces from 2 different contractors plus direct PLC access	One data exchange interface	different data exchange interfaces maintained by ST/MA/IN
<b>Alarms</b>	Alarm integration via TCD	Alarm integration via TCD	Alarm integration via TCD	Alarms handled directly with AB/CO (CAS)
<b>Mimic diagrams</b>	Mimic diagrams provided through ENS	Web mimic diagrams often provided by the contractors	Mimic diagrams maintained by ST/MA/IN	Mimic diagrams often delivered by groups
<b>Comments</b>	No changes from project start to operational phase since 3 years	Project and operation are done by different teams	Data exchange interfaces and installation done by ST/MA/IN	not critical for operation

### 4 INTEGRATION LIFECYCLE

The standard project and integration lifecycle starts with the project launch, definition of the different linkmen and a project planning, followed by the specification and design phase. Afterwards comes the implementation and integration in the TCR, integration tests and the systems change to the operation and maintenance after the reception tests have been successful. The following graphic shows also the persons who are mainly involved in the different phases:



After discussion with the different groups some problems could be identified for each phase. The following chapter explains these problems and proposes some solutions.

#### 4.1 Problems and Solutions

The table shows for each phase the main problems that have been identified and the proposed solution:

Phase	Problem / Solution
Project Launch	<p>Sometimes the project planning does not consider the interaction with the TCR in the integration phase.</p> <p><i>Define a ST/MA linkman at project launch and make sure that he gives the necessary feedback for the project planning</i></p> <p><i>Include the TCR integration phase always from the beginning of planning to make it visible to all project participants.</i></p>
Process Definition	<p>It is not known if special TCR tools or interfaces are required.</p> <p><i>If this issue cannot be clarified at the beginning, some special development should be foreseen in terms of time and budget.</i></p>
Monitoring Design	<p>The operation and monitoring roles are sometimes unclear.</p> <p><i>These should be defined in an early project stage because they are very tied with the design of the control system of the equipment.</i></p> <p>The monitoring needs are unknown or undefined.</p> <p><i>Invite the linkman to all project meetings and include this point to the agenda of the meetings. Often it is sufficient to discuss this point for some minutes just to not forget about this point and to avoid surprises later.</i></p>
Implementation and TCD request	<p>Alarm and signal definition is not stable during the implementation phase.</p> <p><i>Enough time should be invested for a careful alarm and signal definition in the beginning as each later change costs a lot of effort and time after the data has been entered in the databases.</i></p> <p>Development of mimic diagrams for the use in the TCR</p> <p><i>The use of web based mimic diagrams that are developed directly by the equipment groups or their contractors seems to be the most promising approach. In order to ensure a coherence between the different applications, the TCR HCI conventions must be followed.</i></p>
Test / Reception	<p>Sometimes it is unclear if an installation should be monitored or not after the failure of reception tests.</p> <p><i>In general enough time and pre-module-tests should be foreseen to avoid surprises during the equipment tests. In case of failure and non-acceptance repair works or corrections must be carried out before the system changes into operation mode. This must be part of the project management from the beginning of the project.</i></p> <p><i>Clear instructions and TCR operator training must be provided before the systems become operational.</i></p>
Operation and Maintenance	<p>System and interface changes are unavoidable.</p> <p><i>Necessary changes must be planned on both sides and done simultaneously and well coordinated. Therefore a procedure that covers probable changes should be established when the system becomes operational. Some time and budget should also be allocated to cover hard- and software evolution over the equipment lifetime.</i></p>

## **5 CONCLUSION**

In general the equipment integration for monitoring in the TCR environment is well defined by the standard TCD procedure. Most of the technical issues do not cause any major problems. The analysis shows, that some more effort needs to be invested in coordination and planning issues in the different projects. Even if the TCR monitoring is usually a very small percentage of the overall project cost, the investment in coordination and long term thinking pays in the end.

## **6 REFERENCES**

[1] TCD procedure (<http://tcd.web.cern.ch/tcd/>)