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THE CHALLENGES OF THE 'SOFTWARE SUPPORT FOR INDUSTRIAL CONTROLS' CONTRACT.

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Abstract

ST division is currently specifying a 'Software Support for Industrial Controls' contract. The application of this contract and its success will require several changes in our habits for specifying, designing, and maintaining control systems. This paper summarizes some key concepts which should be respected in order to obtain maximum benefits from the future contract and to optimize the software activities in the division. The contract concerns the maintenance and development of the monitoring and control systems used for supervising CERN's technical infrastructure (electrical distribution, cooling water, air conditioning, safety, and access control). The systems concerned consist of computer and communication hardware and software, tailored to provide specific functionalities for the remote operation, command, and monitoring of equipment. All these systems use commercially available software and hardware such as SCADA, PLCs and associated drivers, controllers, fieldbuses, and networks. It is intended to contract out these activities on a results-oriented basis.

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1 INTRODUCTION

The process control and monitoring systems used for operating CERN's technical infrastructure are constrained by their 24 h/365 d availability and high reliability needs. The stability of the technical infrastructure and the efficiency of its supervision have a direct impact on the operation statistics of the CERN accelerator complex. In the present context of Human Resources reduction and outsourcing policy, it was decided to set up a contract to support the maintenance and development of the monitoring and control systems used for supervising CERN's technical infrastructure (electrical distribution, cooling water, air conditioning, safety, and access control). The experience gained with outsourcing control systems has allowed CERN to obtain complete and reliable products delivered on time (see Refs. [1–2]). However, the success of these projects relies on the efforts devoted to the specification and on the project follow-up. The same concept will be extended to maintenance activities.

2 SCOPE

CERN intends to contract out to industry, on a results-oriented basis, the maintenance of some of its industrial control systems and the development of new ones.

The systems to be controlled are:

- cooling and ventilation equipment,
- pumping stations, air conditioning plants, heating plants,
- electrical networks, electrical sub-stations, diesel generators,
- safety systems, access control systems, etc.
- technical infrastructure monitoring,
- management systems for technical infrastructure facilities.

The systems may also be dedicated to more specific accelerator equipment directly involved in the control of particle beams.

The contract will be awarded during the year 2000. It will be concluded within a three-year period with two possible one-year renewals. A global annual budget of 1 MCHF is planned for this activity.

The equipment groups (Electricity, Cooling & Ventilation, Access) of the ST division will mainly require process control related activities. The Technical Control Room (TCR) will require the maintenance and evolution of its monitoring systems. However, the process control and monitoring activities are joined by the data which flows from the process control to the TCR monitoring. Clear interfaces and protocols have been defined and will be used in the design of the new systems.

The strategic aims of the contract are:

- to maintain existing control and monitoring systems which can no longer be maintained by CERN staff due to the decrease of human resources in the division.
- to handle the development of small- and medium-size software-oriented projects required by the construction of the LHC.
- to improve the quality of the monitoring and control systems by using industrial solutions and methodologies.

The selected Contractor should focus on the rationalization of the monitoring and control architecture, applying CERN's recommendations such as those for the use of fieldbuses and PLCs and favouring software re-usability of proven solutions and modules.

3 GENERAL DESCRIPTION

The contract (see Ref. [2]) will be divided into two sections:

- A *Frame Contract* supporting the new development (defined as a project). It will be based on a set of agreed rates for staff of certain categories. The work packages of each project will be evaluated and people will be allocated according to the skills required. Each project will be planned, priced, and negotiated.
- A *Maintenance Service* covering the maintenance of standard hardware and software configurations.

The proportions will be as follows: 70% of the contract will be used for new projects whilst the remaining 30% will be allocated to the maintenance activities.

However, this 30% proportion will increase when the projects developed under the future contract and no longer covered by the warranty period are also maintained by the contractor.

The Frame Contract will cover small- and medium-size software-oriented projects, requiring up to 12 man-months of work and different manpower profiles.

For the development of new systems CERN requires the Contractor to be in charge of the:

- project management (planning, control, reporting, co-ordination),
- user requirements analysis,
- production of system specification,
- feasibility studies,
- developments based upon CERN specifications,
- installation and integration,
- maintenance, support, and training,
- project documentation.

The project development methodology will be based on the ESA PSS–05 Software Engineering standards and, in particular, on the V life-cycle model. For small-size projects, User Requirement and Software Requirement phases may be combined in a single Requirement phase. Architectural and Detailed Design phases may also be combined into a single Design phase.

At the beginning of a new project CERN will provide a User Requirement Document or may require its definition from the Contractor. For every project, a project management plan will be given to CERN within 15 working days. It will summarize the project monitoring method, quality aspects, risk management, staffing, and technical issues. This document will be updated throughout the project’s life cycle.

Particular emphasis will be put on the phase review and testing procedure. Acceptance Testing procedures will be established with CERN at least one month in advance of their execution.

For the maintenance of existing systems, CERN requires:

- corrective maintenance,
- preventive maintenance,
- user support,
- documentation production,
- system administration,
- database administration.

The *Corrective Maintenance* activity has the highest priority. It will be managed by strict activity recording procedures.

The *User Support* and *Administrative tasks* have a lower priority than the *Corrective Maintenance*. CERN and the contractor will agree at the start of each 2-month period on a prioritized set of activities, which correspond to the nominal resources available for this type of work during the coming period.

The planning of the *System Administration and Database Administration* tasks will be described in the Quality Assurance Plan (QAP) of the contract. They will be performed on a routine basis.

During the first six months of the contract, the Contractor will analyse the system being maintained, update the documentation if necessary, learn and set up the procedures applicable, and define and maintain the spare parts. At the end of this period CERN and the Contractor will review the Maintenance Service, and the Contractor will take over the responsibility of the defined system.

4 DISCUSSION

CERN's experience with outsourcing control systems has demonstrated its advantages: complete and reliable products delivered on time. A good example of the practice of outsourcing the development of a control system carried out by ST in the past is given in Ref. [3]. However, success depends on the correct use of software engineering methods such as ESA PSS–05, and on project follow-up methods such as GDPM (Goal Directed Project Management). Particular efforts are required during the specification phase. Clear specifications will ease the design process, the project follow-up, and optimize the cost of the product by minimizing the risk factor applied by the contractor. A detailed specification will also allow CERN to monitor the cost of the project by a precise estimation of the manpower and profile involved.

With respect to the maintenance of the existing software, the final aim is to define a Service Level Agreement (SLA). However, defining a SLA is only realistic for systems that have been designed, developed and maintained with industrial practices, and for which complete documentation exists. The definition and documentation of the maintenance tasks and intervention procedures are probably the most difficult part in the elaboration of the contract.

The operation support will be organized using a problem reporting system where every problem will be logged and traced. For each type of intervention an investigation time and a maximum intervention time will be defined. Statistical analysis of the interventions will give a better understanding of the cause and importance of the problems, and will then allow the consolidation tasks of the various control systems involved to be prioritized. A weekly meeting will be organized with the contractor to monitor the status of all the problems reported and the action taken to resolve them. This meeting will also ensure that long-lasting solutions eliminating the cause of the problems are implemented.

Software configuration management practices are crucial to ensure the integrity of the operational software and the quality of new software developed. Therefore a Software Configuration Management System (SCAMS) will be used to support both activities (see Ref. [4]).

5 CONCLUSIONS

This contract will help the ST Division to prepare the monitoring and control systems for the LHC era with the final objective of improving the quality of the monitoring and control systems used for CERN's technical infrastructure.

For the development of new systems, the goal is to obtain complete and reliable products delivered on time, by means of standard methods, tools, and solutions.

Furthermore, the definition of the maintenance activities, and the tracing of the interventions and the solutions applied should improve the operational quality of the systems concerned.

Special care should be exercised with the monitoring of the project, given that the contractor could consider itself to be in a monopoly position. CERN should also be aware of the possible loss of internal knowledge of its systems. Nevertheless, the knowledge gained by collaborating with industry for the maintenance and development of IT systems will improve the quality of our projects and operational tasks. A support contract for industrial controls has not yet been drawn up at CERN. The experience of other organizations such as ESA, who have used this type of contract for several years, should be used. The ST Division will set up this contract for its own systems. Other Divisions (SL, LHC) have also shown an interest and could join at a later stage.

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REFERENCES

[1] P. Ciriani, Trends in industrial control systems, First ST Workshop, Chamonix, 1998.

[2] B. Denis, Control systems outsourcing perspectives, First ST Workshop, Chamonix, 1998.

[3] P. Ninin, Software Support for Industrial Controls, Technical Specification and Service Definition, IT2711.

[4] E. Hatziangeli et al., A common software configuration management system for CERN SPS and LEP accelerators and technical services (these proceedings).