QUALITY ASSURANCE

FOR THE ATLAS PROJECT

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May 2000

CONTENTS

[redacted]

"To build the best detector for minimum cost"

Quality Assurance is required to turn the conceptual design of ATLAS into a real detector which shall:

- **attain the required performance**
- **be safe, reliable and maintainable**
- **be completed and running in time**

Quality Assurance is the set of planned and systematic activities to ensures that the Project will meet its specifications

[redacted]

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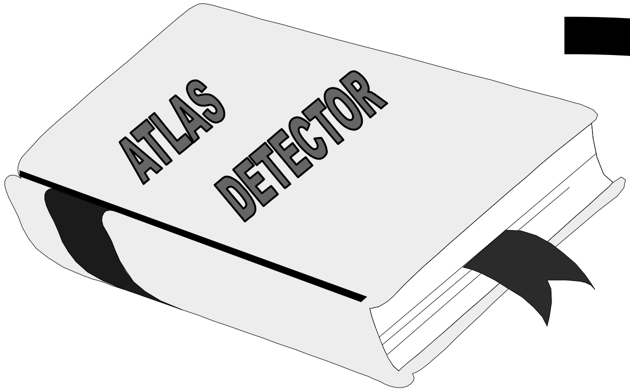
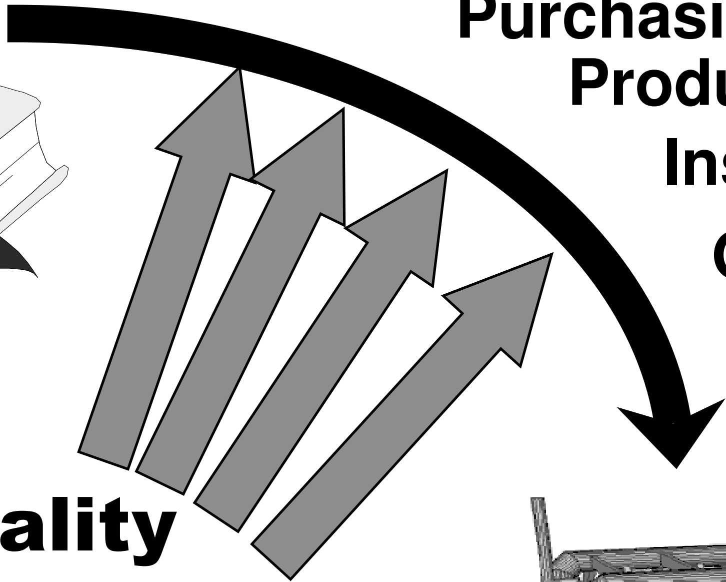
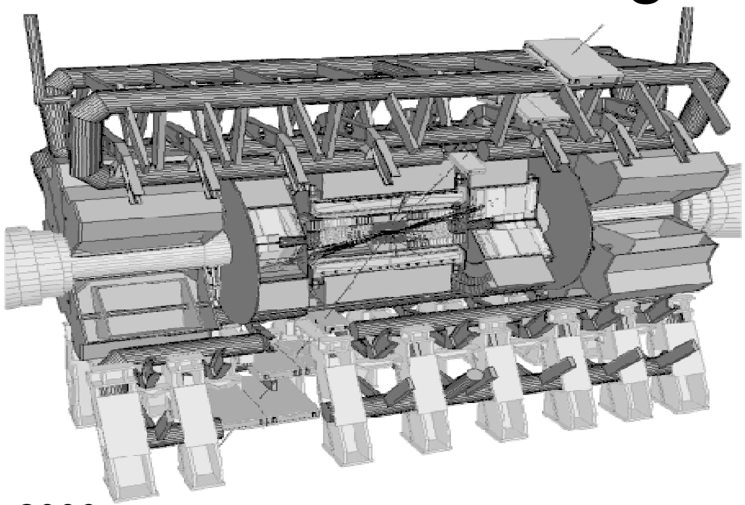


Planning
Design
Purchasing
Production
Installation
Operation
Maintenance
Dismantling





Quality
Assurance

[redacted]

ISO 9000:2000 quality management concept:

- **All work is accomplished by a process**
- **Processes have inputs and outputs**
- **Processes involve people and resources**

Quality Management means:

- **To apply tools and resources for establishing a sufficiently high and constant quality level**
- **The continuous effort to tune the process towards higher quality**

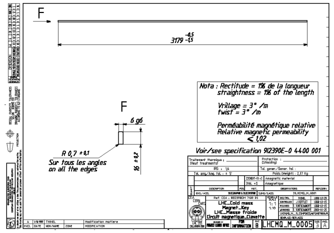
QUALITY MANAGEMENT: A PROCESS

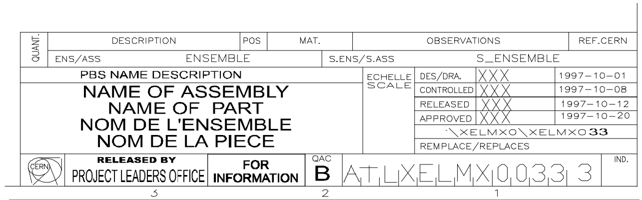
INPUTS → **Process** → **OUTPUTS**

Process

A value-adding transformation involving people and other resources

EXAMPLE



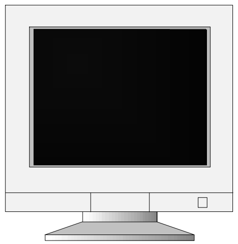


Approval of a drawing

Hans	**Helfrich**
Alois	**Chritin**
Jacques	**Lettry**
Alain	**Nobs**
Roger	**Popeline**
Daniel	**Taddei**

Approval Start	25. 01. 00	Deadline	31. 01. 00
Approval Leader	Hans	Helfrich	
Approved			30. 01. 00

PEOPLE



COMPUTER

INPUTS:

- **Drawing**
- **List of names**

OUTPUTS:

- **A decision**
- **A list of comments**
- **An approved drawing**

INTRODUCING QUALITY ASSURANCE

- Identify critical processes
- Identify key roles
- Identify key documents
- Define check points

Formalized in a Quality Assurance Plan

- Apply the QAP procedures to the project activities
- Get feedback and use it to introduce improvements (Plan-Do-Check-Act, PDCA cycle)

EFFICIENT COMMUNICATION

Large number of people

Different cultures

What is a twister?

What is a baseline?

Define a common project “language” to communicate effectively

QA: PROVIDING CONFIDENCE IN THE PROJECT

- **Document processes**
- **Define check-points**
- **Maintain efficient communications**
  - **Progress can be followed**
  - **Potential problems are detected early**
  - **Traceability is possible**

Quality assurance adds transparency to the Project's development

QAP STRUCTURE

Policy

Quality assurance requirements for the ATLAS Project

Definitions

Common conventions in use throughout the Project

WHY is it done

Procedures

Courses of actions to implement QA policies

WHO does WHAT and WHEN

Standards

Detailed requirements for Project documents

Document Templates

For sharing a common structure and layout

Instructions

Step by step instructions for the execution of specific tasks

HOW is it done

QAP AVAILABILITY AND UPDATES

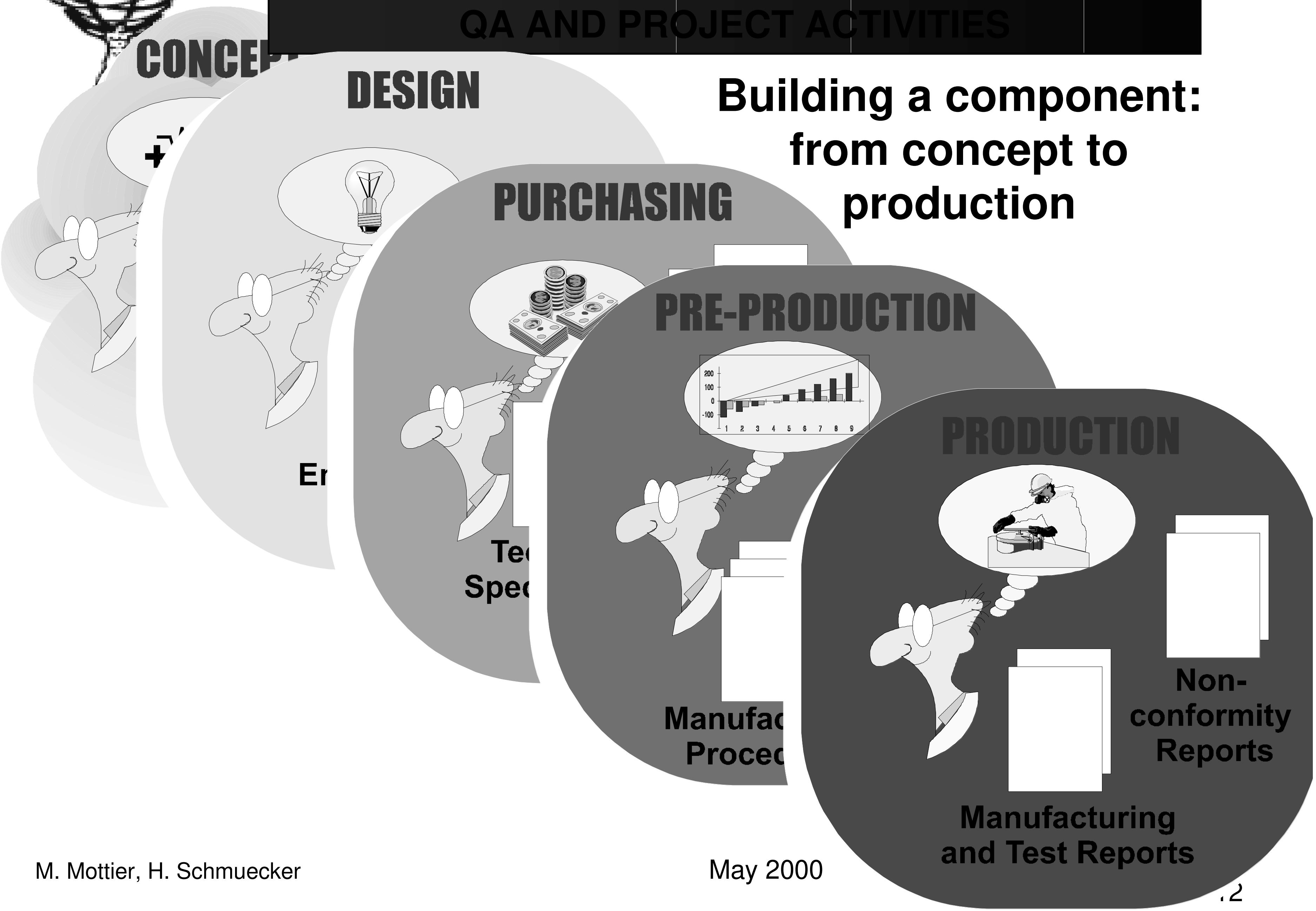
On the web

- **CERN**
  - **Experiments**
    - **ATLAS**
      - **Collaboration**
        - **Technical Co-ordination**
          - **Quality Assurance**

Updates

- **New documents and new versions are put on the web as they become available**
- **New documents and new revisions are advertised via the mailing list "Quality Assurance Information"**

QA AND PROJECT ACTIVITIES



Building a component: from concept to production

DESIGN: OBJECTIVES

The essential quality aspects and the requirements for performance, safety, reliability are established during the design and development stage.

- **Promote uniform methods of design**
- **Verify that the design output meets the design input specifications**
- **Expose the design to persons outside the design team for evaluation**
- **Beware of <u>too tight</u> specifications**
- **Record the design decision process**
- **Record the design change history**

DESIGN: PLANNING

What has to be considered:

- **NAMING CONVENTIONS (see PBS)**
  - **EQUIPMENT CODES**
- **IDENTIFICATION OF PERSONS IN CHARGE OF APPROVING:**
  - **DRAWINGS**
  - **SPECIFICATIONS**
  - **ENGINEERING CHANGE REQUEST (ECR)**
- **QUALITY ASSURANCE CATEGORIES**

ATLAS PART IDENTIFICATION

ATC-OQ-QA-2040

4. Structure of the ATLAS Part Identifier

The primary role of the ATLAS Part Identifier is to serve as a unique key permitting to search for and retrieve efficiently all pertinent information about instances of parts stored in logbooks or databases………………..

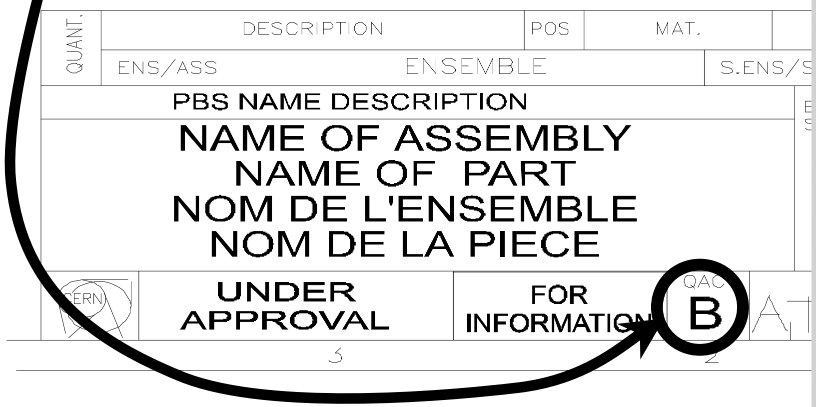
DESIGN PLANNING: QA CATEGORIES

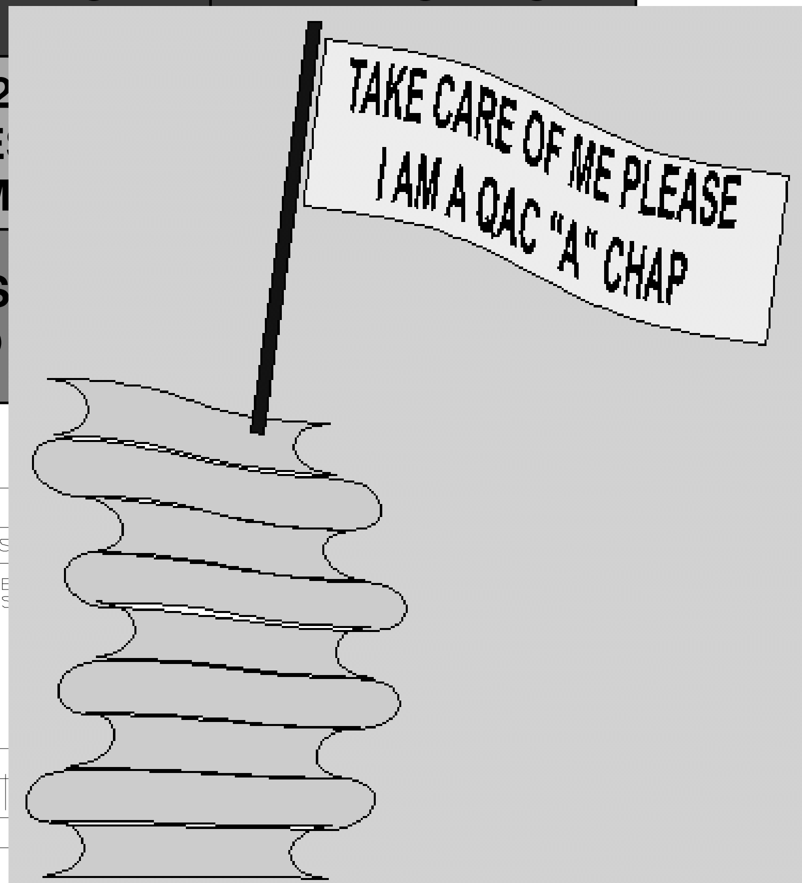
A graded approach to Quality Assurance is applied (see ATC-OQ-QA-2050). This requires risk analysis (Failure Mode and Effect Analysis, FMEA) on items. A failure might cause:

- **A safety, health or environmental hazard**
- **a monetary loss through damage, repair or scrap**
- **a loss of availability of the detector**
- **a degradation of performance**

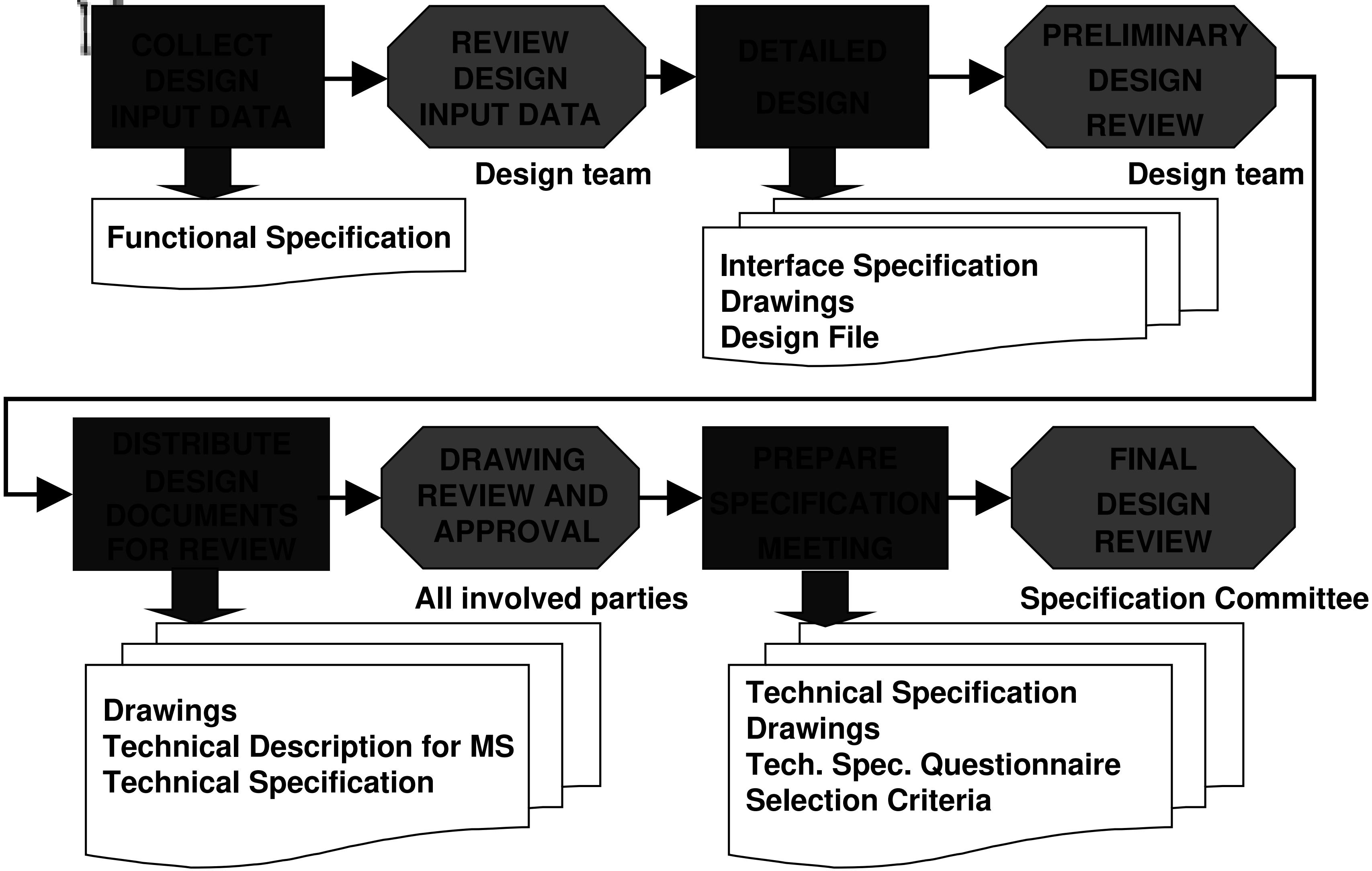
DESIGN PLANNING: QA CATEGORIES

CATEGORY	IMPACT OF FAILURE	FINANCIAL LOSS	UNSCHEDULED DOWNTIME
A	CATASTROPHIC	OVER 2 MCHF	1 WEEK OR MORE
B	SIGNIFICANT	OVER 2 AND LES 2 M	
- (NONE)	MINOR	LESS 2OO	



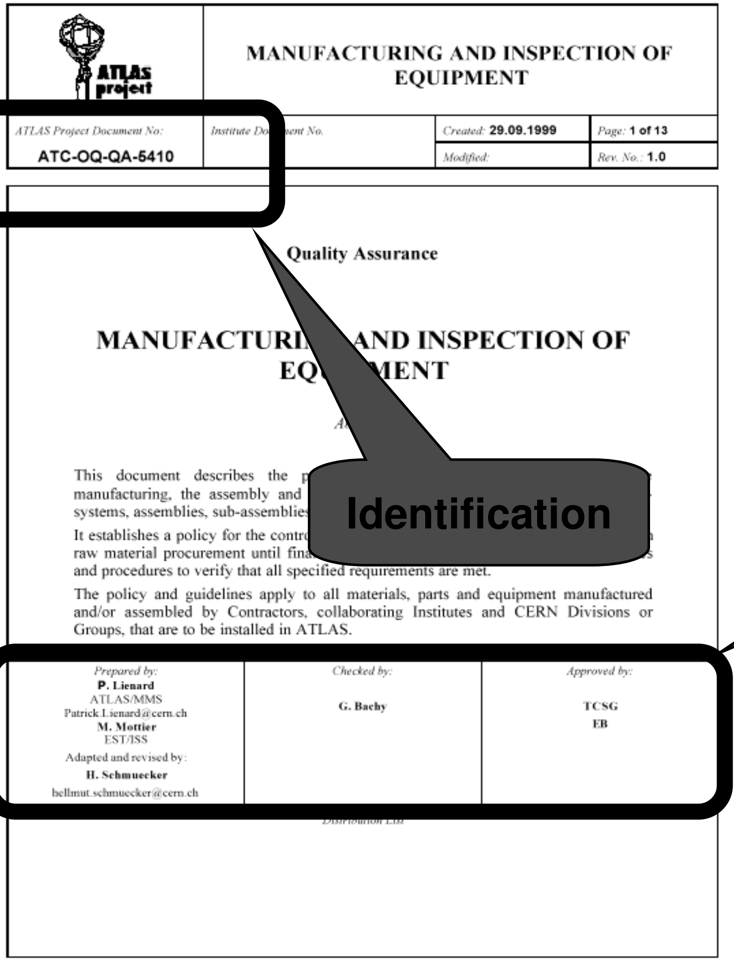


THE DESIGN PROCESS



Quality Assurance for the ATLAS Project

DESIGN: DOCUMENTS



ATLAS project

MANUFACTURING AND INSPECTION OF EQUIPMENT

ATLAS Project Document No:	Institute Do[...]ent No.	Created: 29.09.1999	Page: 1 of 13
ATC-OQ-QA-5410		Modified:	Rev. No.: 1.0

Quality Assurance

MANUFACTURI[...] AND INSPECTION OF EQ[...]MENT

This document describes the p[...] manufacturing, the assembly and [...] systems, assemblies, sub-assemblies [...]

It establishes a policy for the contr[...] raw material procurement until fina[...] and procedures to verify that all specified requirements are met.

The policy and guidelines apply to all materials, parts and equipment manufactured and/or assembled by Contractors, collaborating Institutes and CERN Divisions or Groups, that are to be installed in ATLAS.

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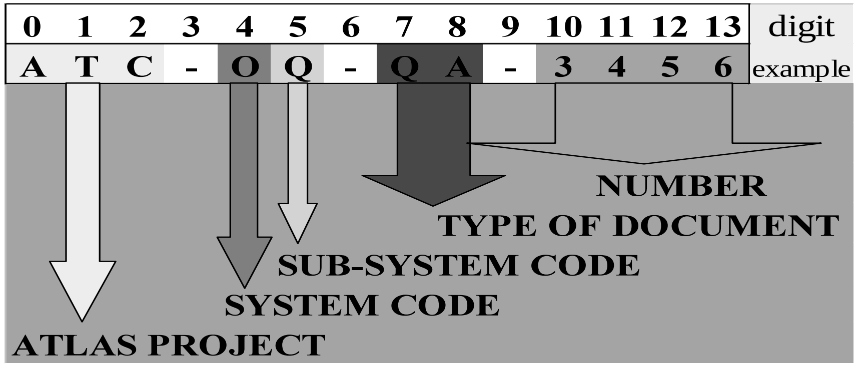
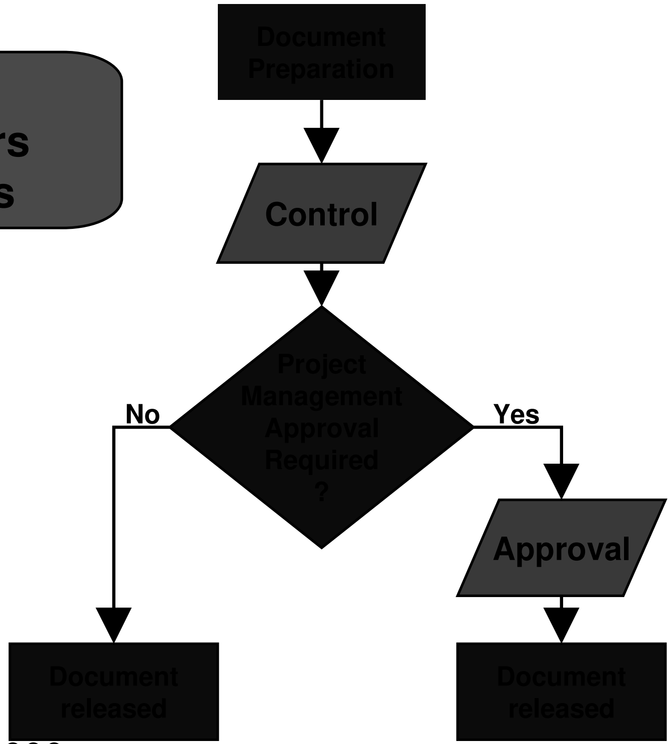
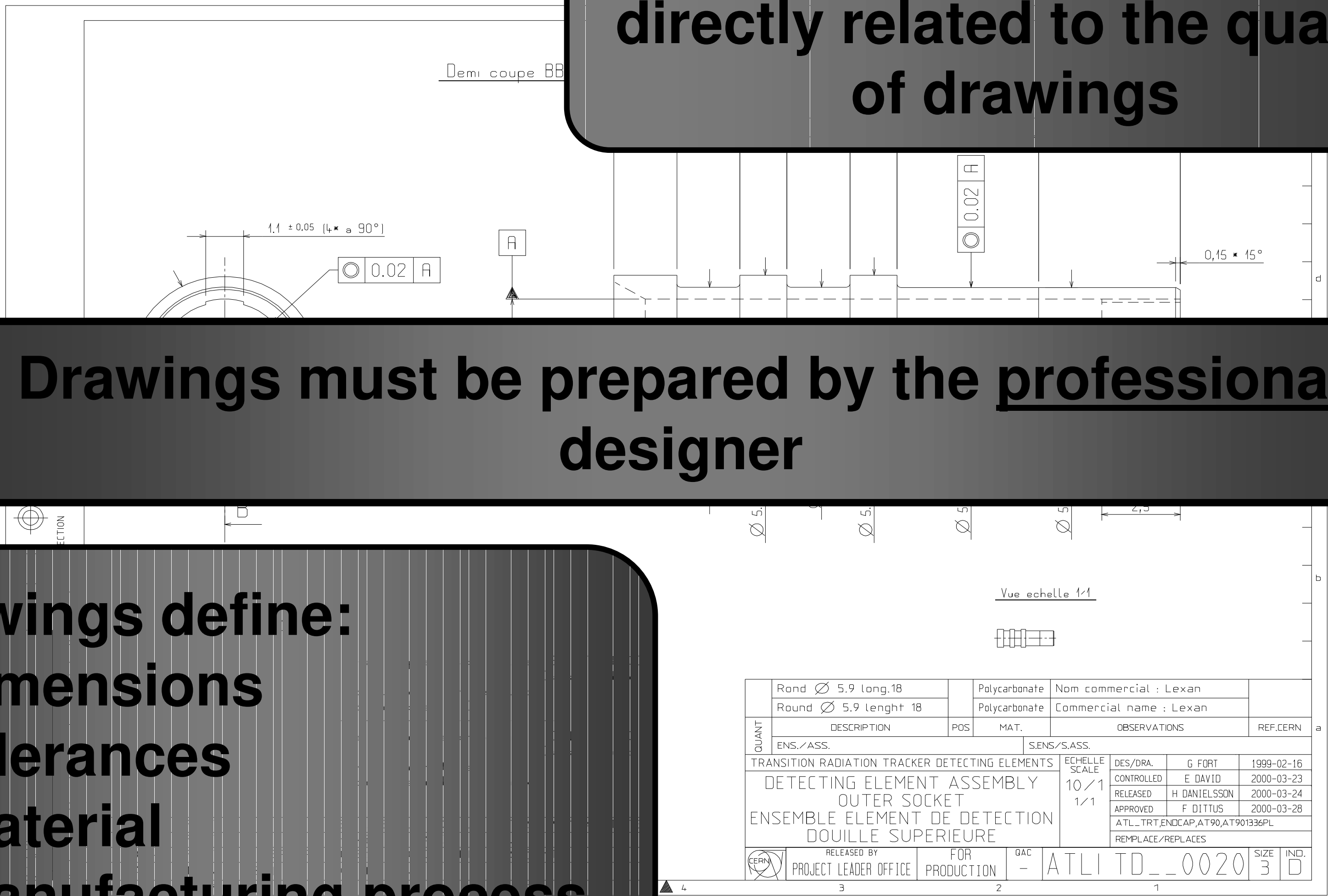




DESIGN: DRAWINGS

Cost and performance are directly related to the quality of drawings

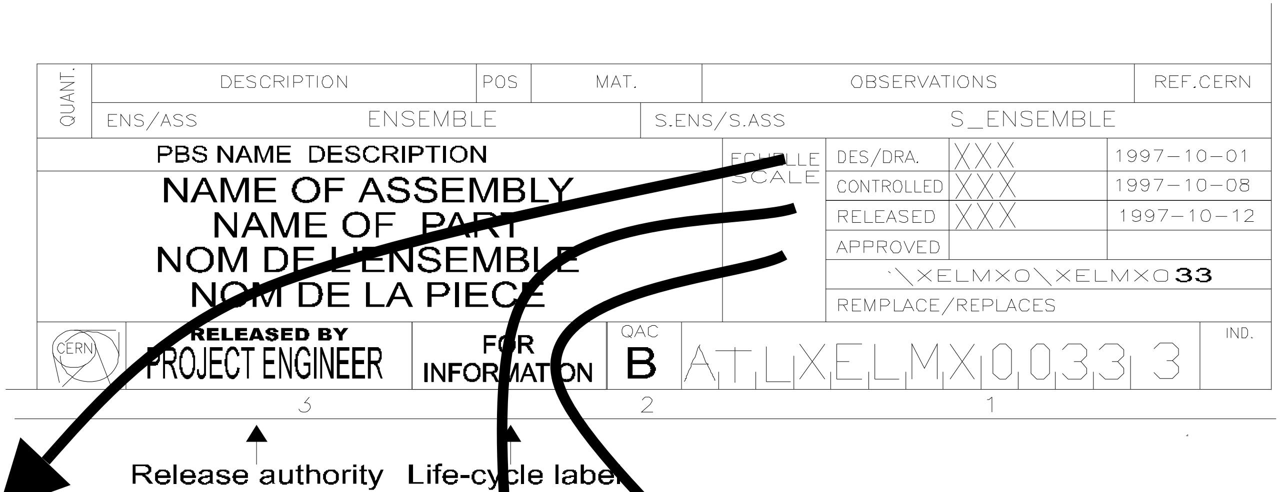


Drawings must be prepared by the <u>professional</u> designer

Drawings define:

- **dimensions**
- **tolerances**
- **material**
- **manufacturing process**

DESIGN: DRAWINGS



- Drawing practices and standards (ISO, DIN, BS, ASME) are respected
- No obvious mistakes or omissions

Design represents what is required

Design fits in with the overall project requirements

QAP in DESIGN

QAP related documents

ATC-OQ-QA-2050	Quality Assurance Categories
ATC-OQ-QA-2030	Document Identification System
ATC-OQ-QA-2040	ATLAS Part Identification
ATC-OQ-QA-2032	ATLAS Institute Codes

ATC-OQ-QA-2035	Documents Process and Control
ATC-OQ-QA-2060	Configuration Management Process and Control
ATC-OQ-QA-5130	Drawing Management and Control
ATC-OQ-QA-5110	Design Process and Control

ATC-OQ-QA-5120	Design Stands.-Mechanical Engineering and Installations

PURCHASING: OBJECTIVES

- **Ensure that specifications:**
  - are complete, clear, to the point, and understood
  - refer to international standards
  - concentrate on performance rather than technical details
- **Verify that your purchasing rules are respected**
- **Obtain keen but balanced competition amongst bidders**
- **Control and verify the potential of suppliers**
- **Verify the compatibility of bids with qualification criteria**

PURCHASING: THE TECH. SPECIFICATION

The Technical Specification template provides a common structure

Table of Contents

Chapter 6.1: Quality Assurance Provisions:

The objective is to establish YOUR confidence in the contractor's quality assurance system

Chapter 6: Quality Assurance Provisions

for contracts requiring the design/development of the product and its production

Quality Assurance Policy	**ATC-OQ-QA-1010**
Glossary	**ATC-OQ-QA-2010**
Planning and Scheduling Process and Control	**ATC-OQ-QA-3080**
Quality Assurance Categories	**ATC-OQ-QA-2050**
Design Process and Control	**ATC-OQ-QA-5110**
Drawing Management and Control	**ATC-OQ-QA-5130**
Drawing Process-External Drawings	**ATC-OQ-QA-5131**
Configuration Management - Change Process And Control	**ATC-OQ-QA-3060**
Manufacturing and Inspection of Equipment	**ATC-OQ-QA-5410**
Handling of Non-conforming Equipment	**ATC-OQ-QA-5420**
ATLAS Part Identification	**ATC-OQ-QA-2040**

Chapter 6: Quality Assurance Provisions
for contracts involving manufacturing only

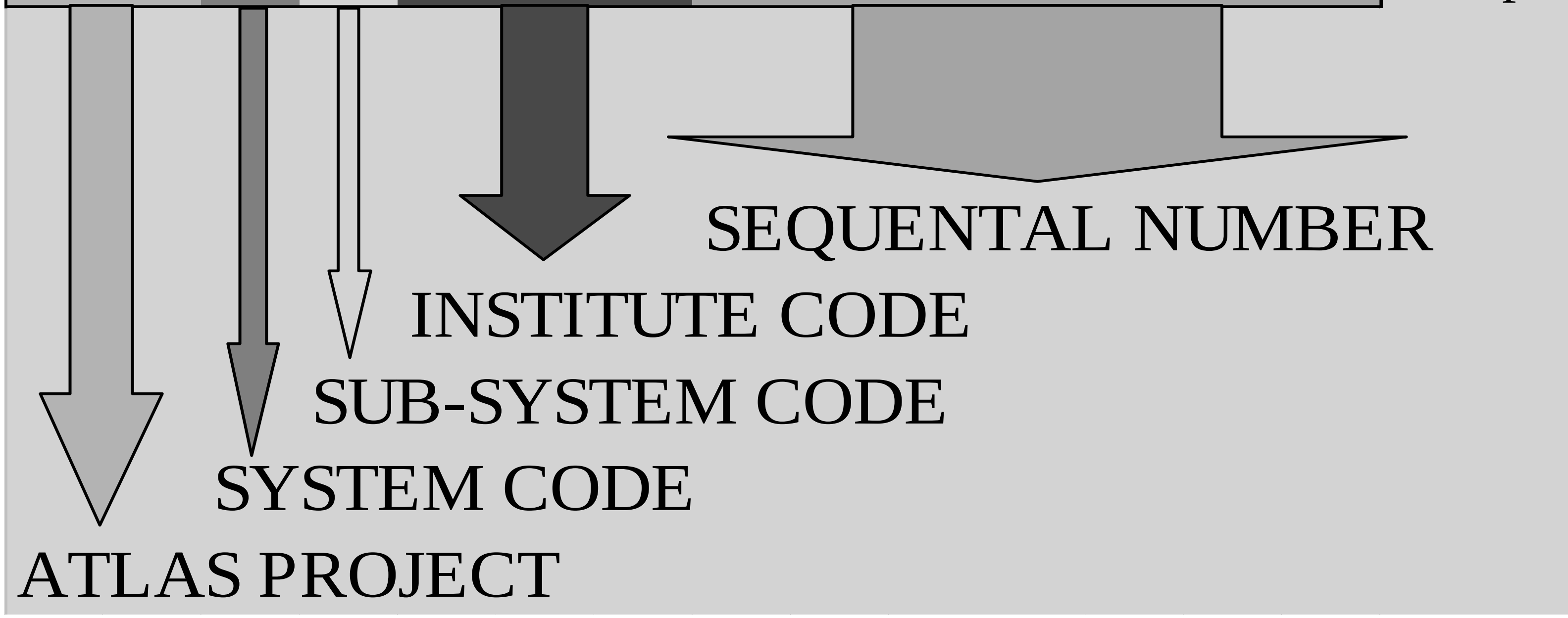
Quality Assurance Policy	ATC-OQ-QA-1010
Glossary	ATC-OQ-QA-2010
Planning and Scheduling Process and Control	ATC-OQ-QA-2080
Drawing Process-External Drawings	ATC-OQ-QA-5131
Manufacturing and Inspection of Equipment	ATC-OQ-QA-5410
Handling of Non-conforming Equipment	ATC-OQ-QA-5420
ATLAS Part Identification	ATC-OQ-QA-2040

PRODUCTION: OBJECTIVES

- **Control of the manufacturing process**
  - **HOW is the product made**
- **Inspection and tests**
  - **Check that the specifications are met**
- **Control of non-conforming product**
  - **WHAT to do if a specification is not met**
- **Handling, storage, packing and delivery**
  - **HOW to avoid damaging the finished product**
- **Product identification and traceability**
  - **Identify the product so that the origin of materials and parts and the processing history can be traced**

ATLAS PART IDENTIFICATION

<<<<<<<prefix>>>>>>>							<sequential number>							
0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	digit
2	0	I	T	H	A	M	0	1	2	3	4	5	6	example



PRODUCTION: PREPARATION

During the production, data and documents prepared by the supplier must be transferred to <u>your local data base</u>:

- **Manufacturing drawings**
- **Other documents such as manufacturing and test procedures**

Communication channels with the supplier must be established and tested <u>before</u> production starts:

- **Computer application used - file formats**
- **Method of transfer: Internet or CD-ROM**

Local data base shall transcribe this information to the CERN's <u>ATLAS PRODUCTION DATA BASE</u> at a later date

PRODUCTION : DOCUMENTS FROM THE SUPPLIER

Guiding principles:

- **Documents are in digital form**

  Produced with computer applications, stored in a computer database

- **Suppliers use their own applications and standards**

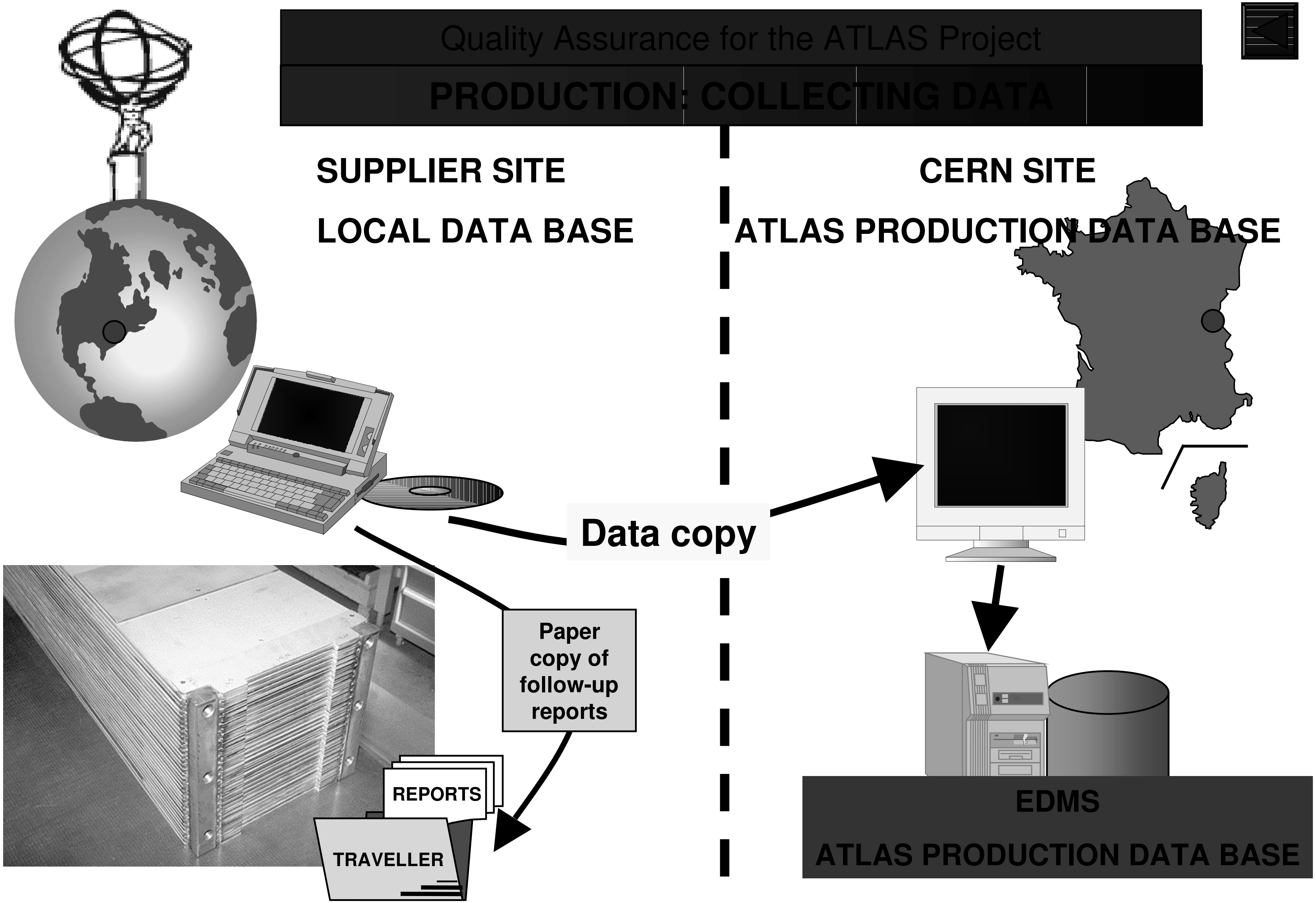
  But they must be able to provide copies of documents and copies of drawings in an agreed digital format

- **Documents/drawings must have an ATLAS Project number**

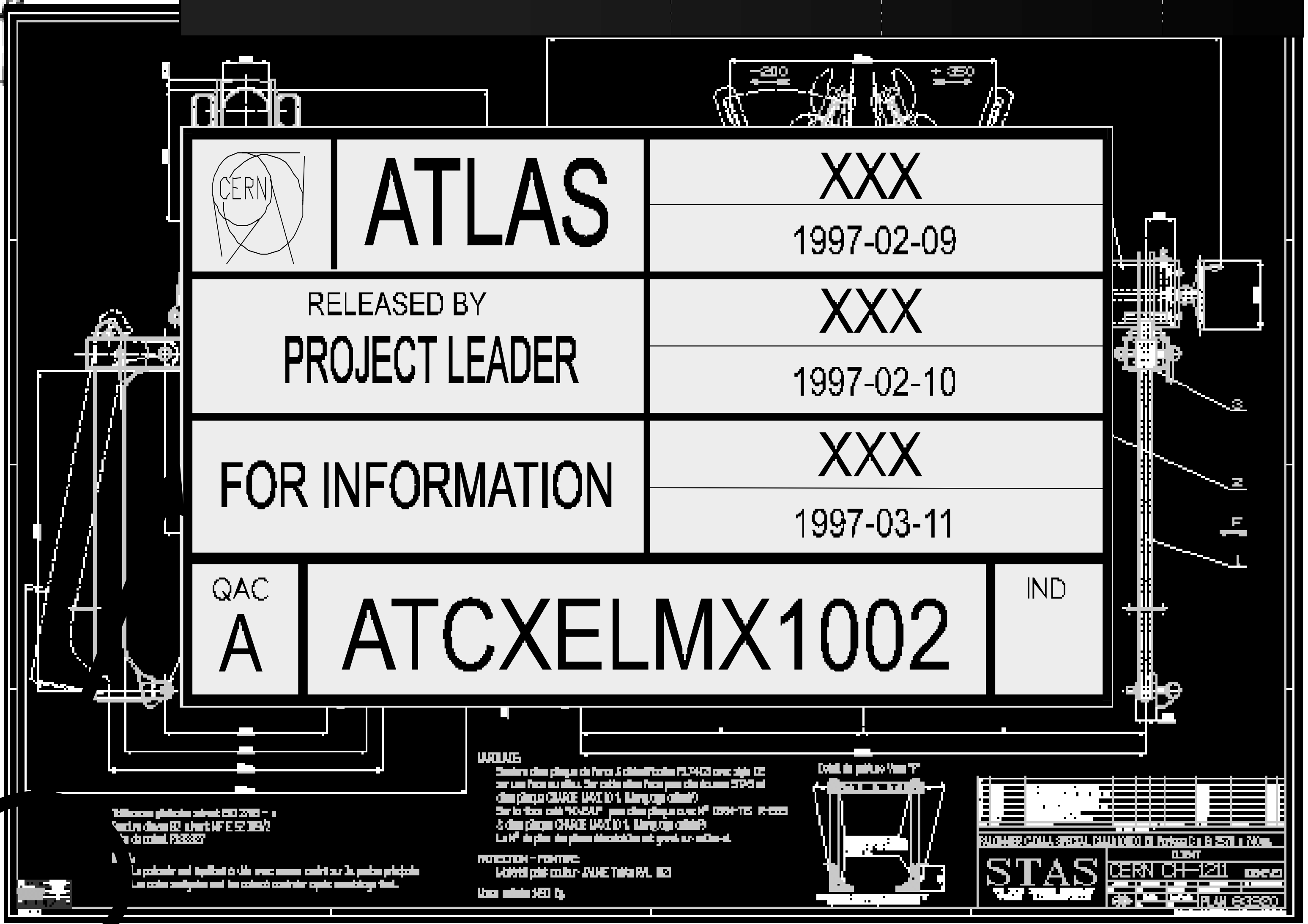
  The supplier is free to use his own number as well

- **Documents must be written in English**

PRODUCTION: COLLECTING DATA

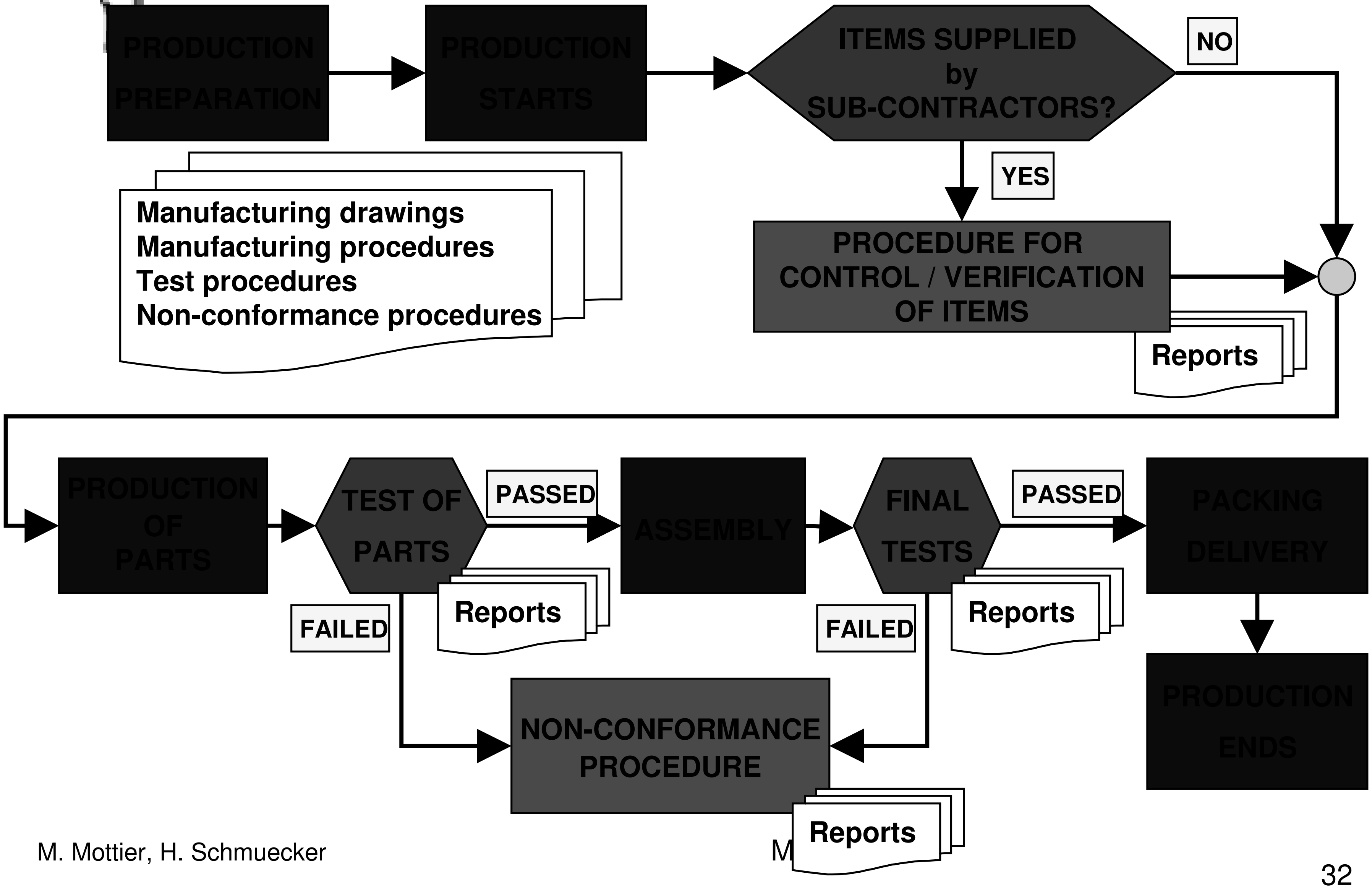


PRODUCTION: MANUFACTURERS DRAWINGS



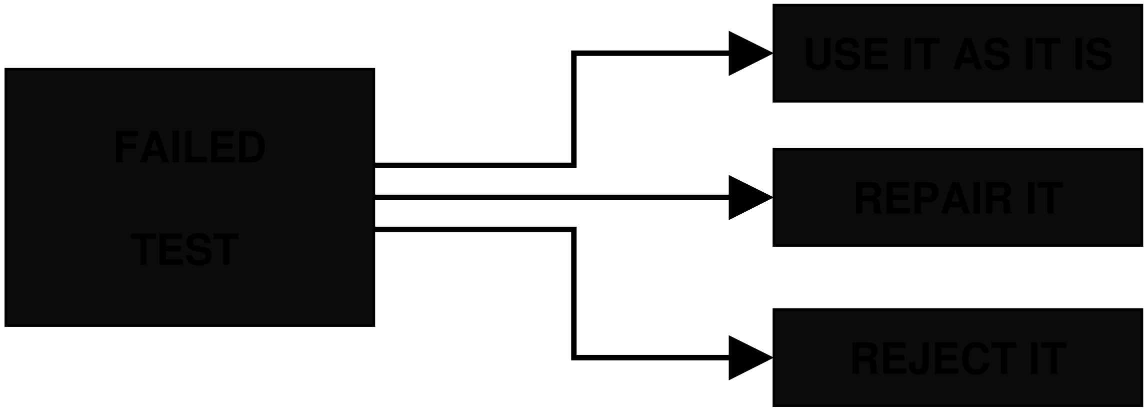
Quality Assurance for the ATLAS Project

THE PRODUCTION PROCESS



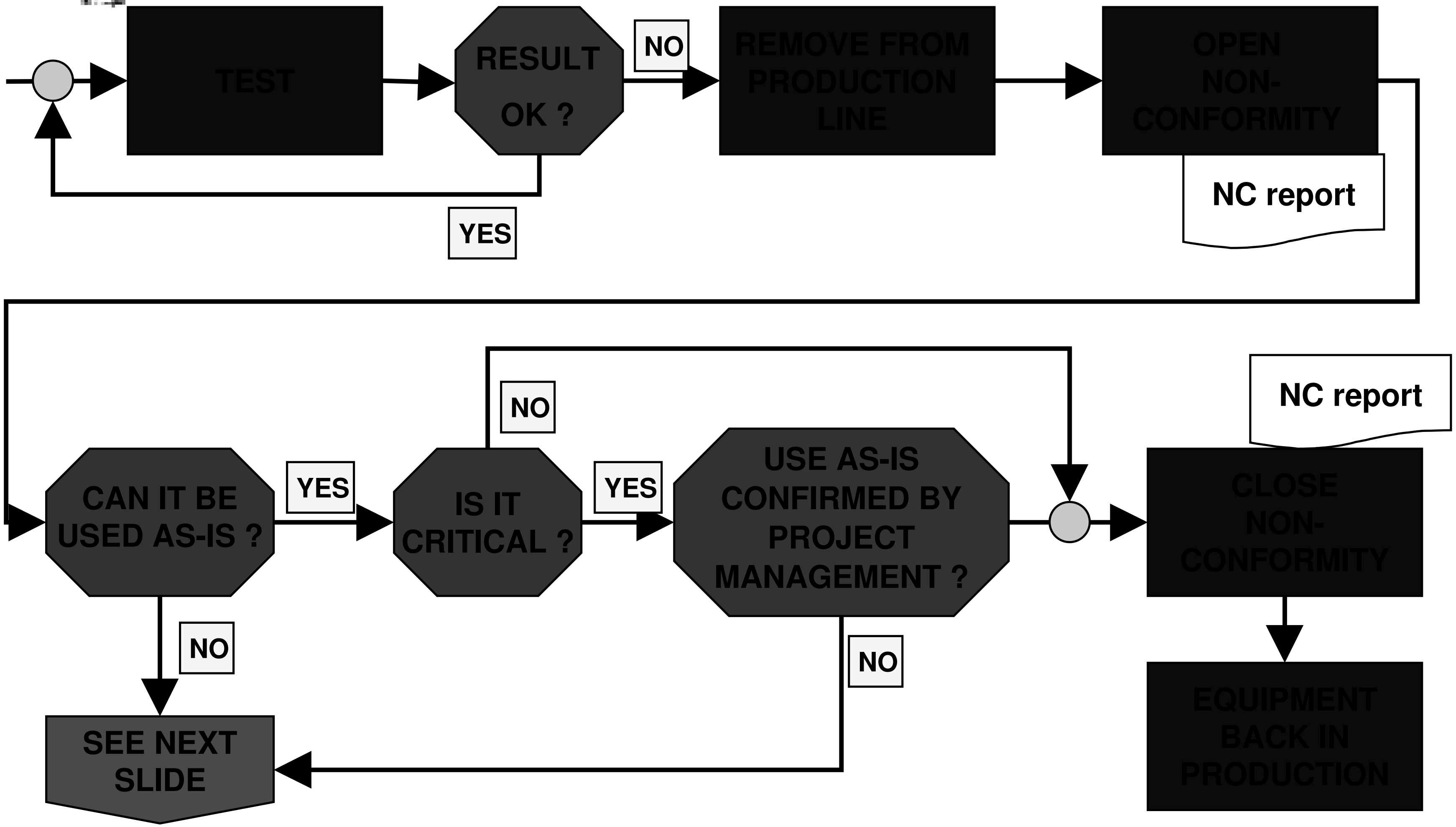
NON-CONFORMANCE: OBJECTIVES

- Make sure that non-conforming equipment is prevented from being installed
- Eliminate or minimize the reoccurrence of problems leading to non-conformance
- Make sure that all non-conformities are documented and traceable

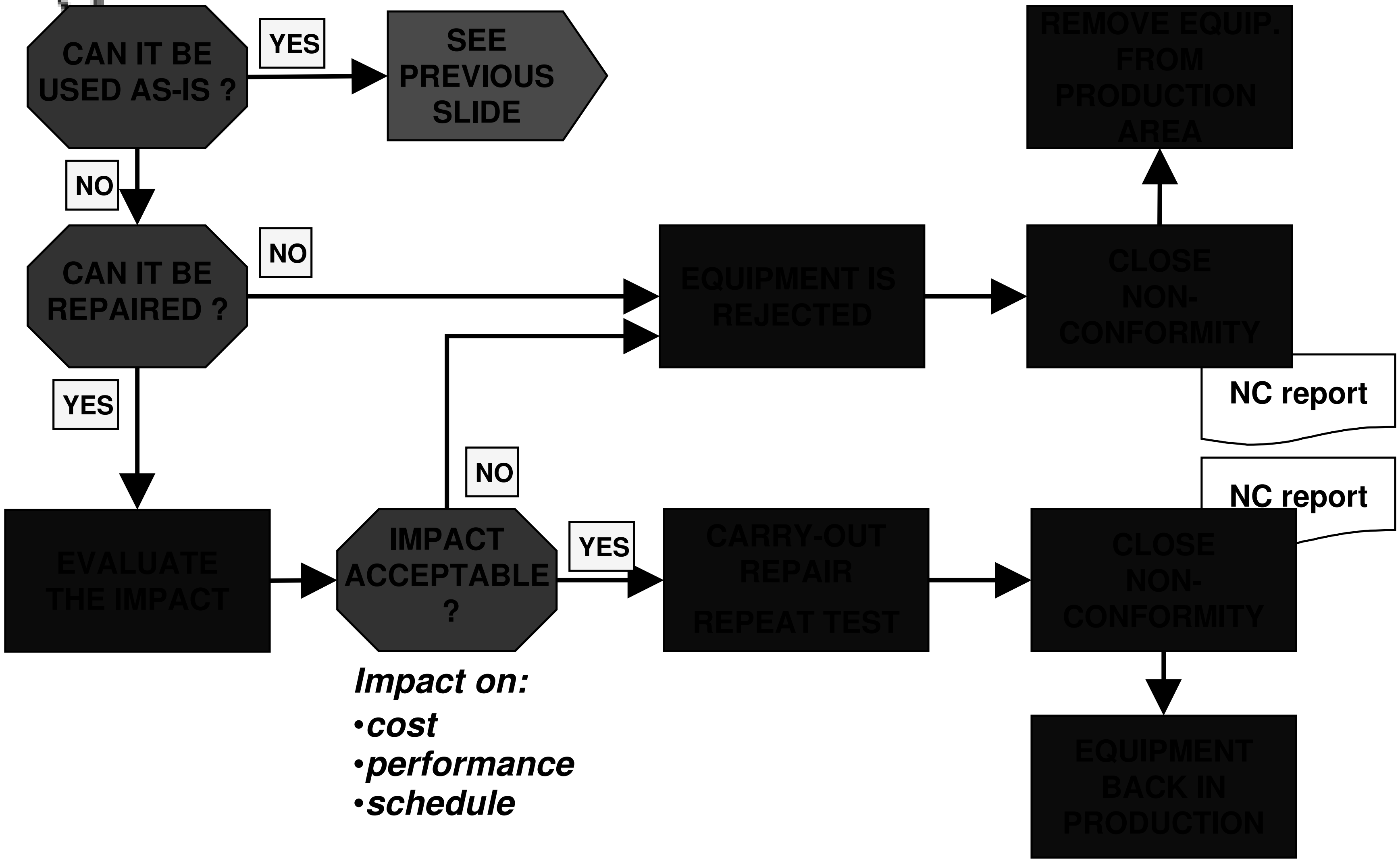


Quality Assurance for the ATLAS Project

NON-CONFORMANCE: USE AS-IS



NON-CONFORMANCE - REPAIR or REJECT



QAP IN PRODUCTION

QAP related documents

ATC-OQ-QA-2040	ATLAS Part Identification

ATC-OQ-QA-3080	Planning and Scheduling Process and Control
ATC-OQ-QA-5130	Drawing Management and Control
ATC-OQ-QA-5410	Manufacturing and Inspection of Equipment
ATC-OQ-QA-5420	Handling of Non-conforming Equipment

[redacted]

As the technical requirements of the Project become better defined with time, changes take place. Changes are risky if:

- **They are introduced in secrecy to avoid big discussions and critics.**
- **They implicate changing boundary conditions on other areas of the design of the detector**

Engineering Change Request (ECR) is there to eliminate, or at least limit, the risks associated with change

CHANGE CONTROL: OBJECTIVES

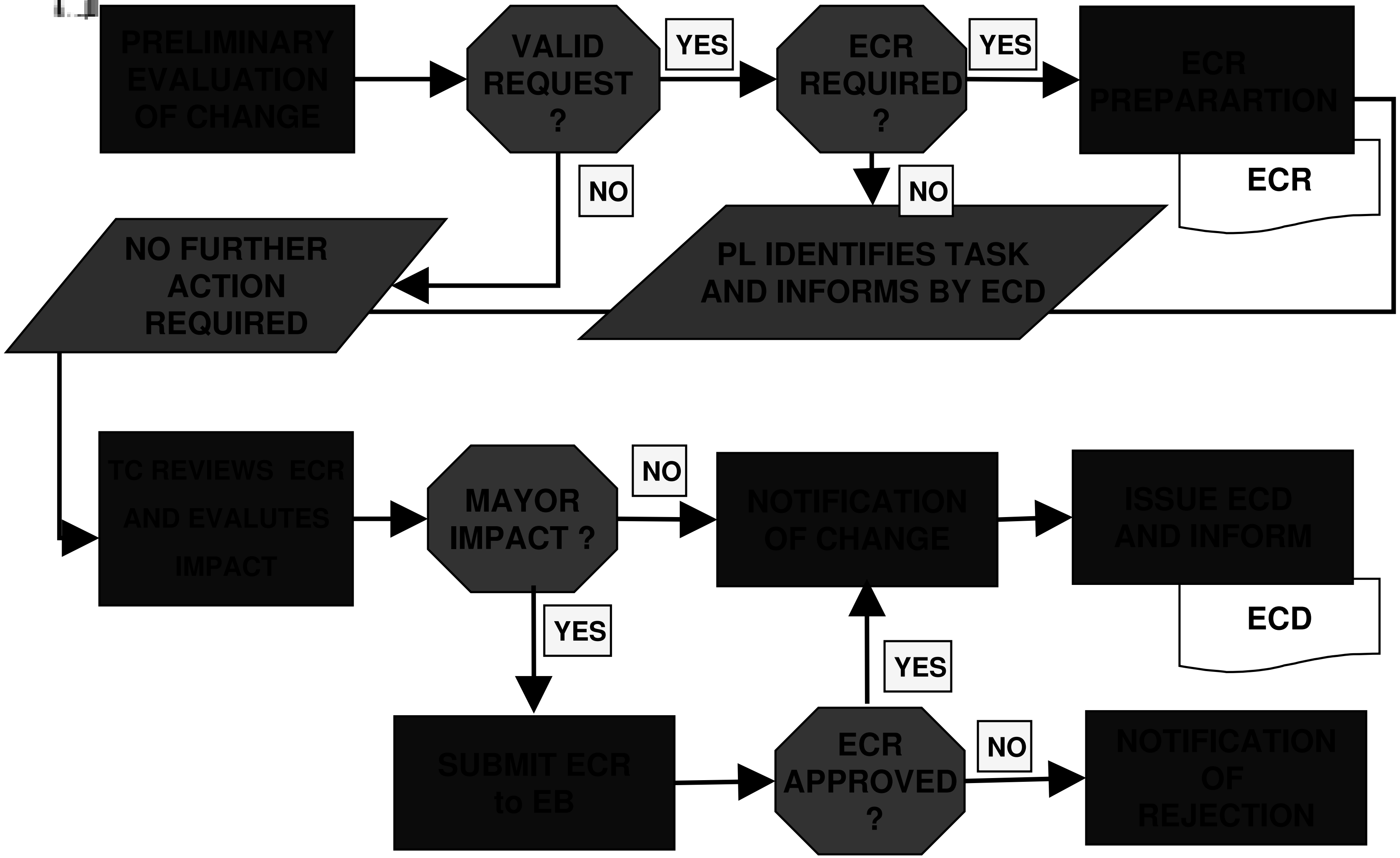
The Engineering Change Request (ECR) is to:

- **Make sure that the impact of changes on performance, cost and schedule are identified and evaluated before they are applied**
- **Make sure that decisions to change are made at the appropriate management level**
- **Ensure the consistency of parameters, requirements, hardware configuration and functional configuration of the detector**

Engineering Chance Request (ECR) is required, if the proposed change will:

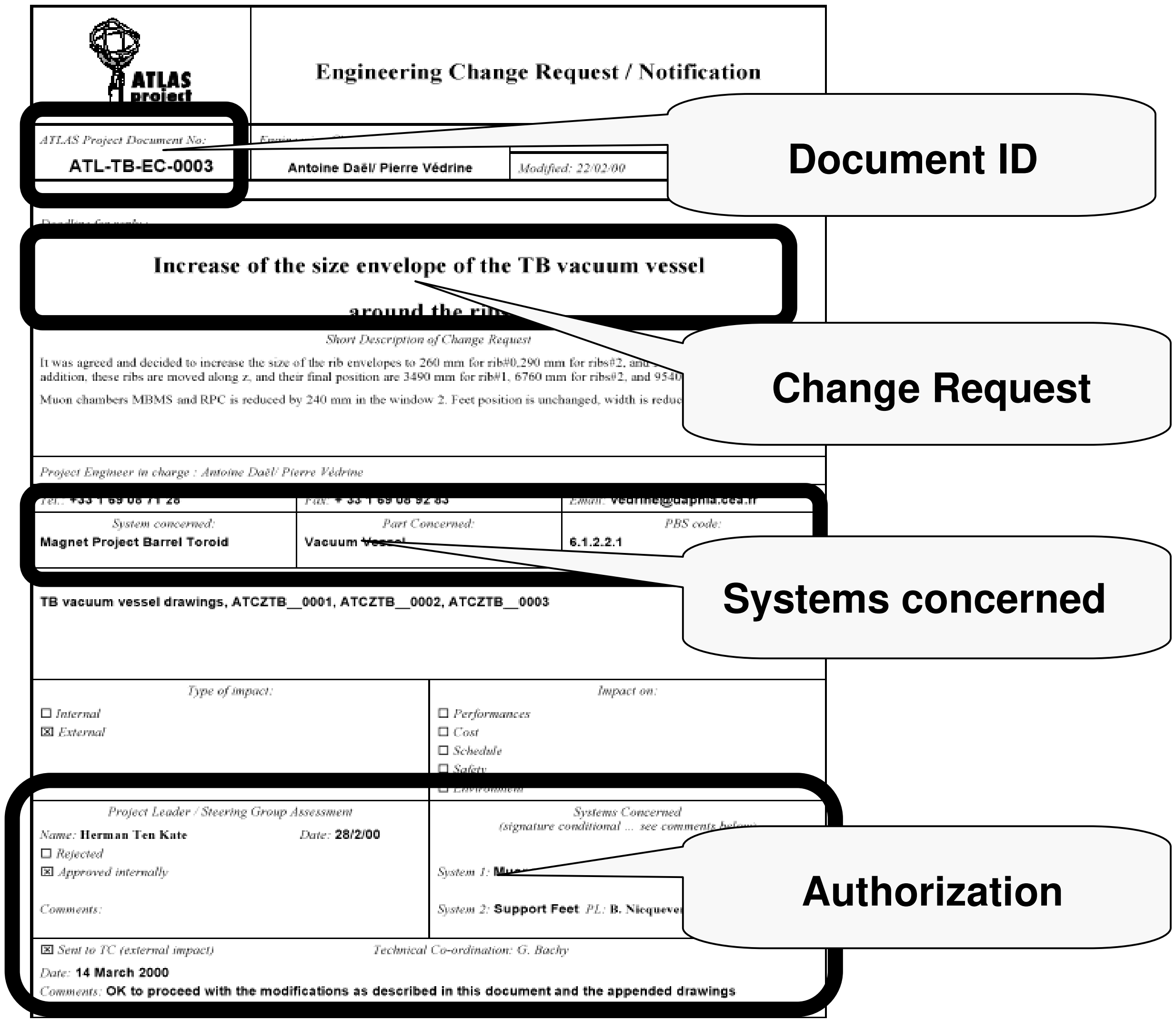
- ◆ have an impact upon ATLAS detector overall performance
- ◆ interfere with other systems
- ◆ result in significant cost and/or schedule changes
- ◆ has an impact on safety and/or environment

THE CHANGE CONTROL PROCESS



CHANGE CONTROL: ECR DOCUMENT

Template
ATL-TC-EG-0002



QAP related documents

ATC-OQ-QA-3060 — **Configuration Management Process and Control**

ATC-TC-EG-0002 — **Template for the Engineering Change Request**

DOCUMENT CONTROL: OBJECTIVES

In the ISO 9000:2000 quality assurance concept, document control it is a basic requirement in QUALITY ASSURANCE.

Document control means managing the creation, approval, distribution, revision, storage and disposal of document.

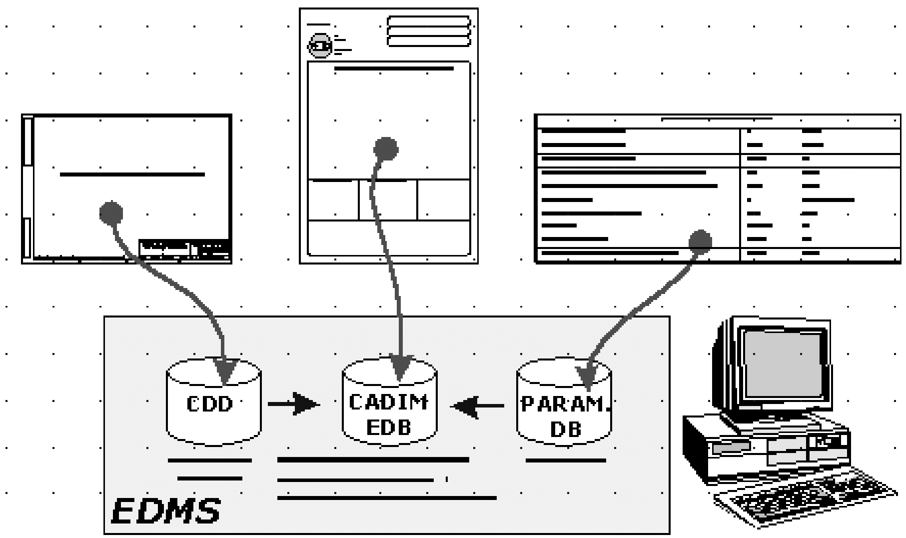
All people involved in the project must have access to the documentation and data needed to fulfil their responsibilities.

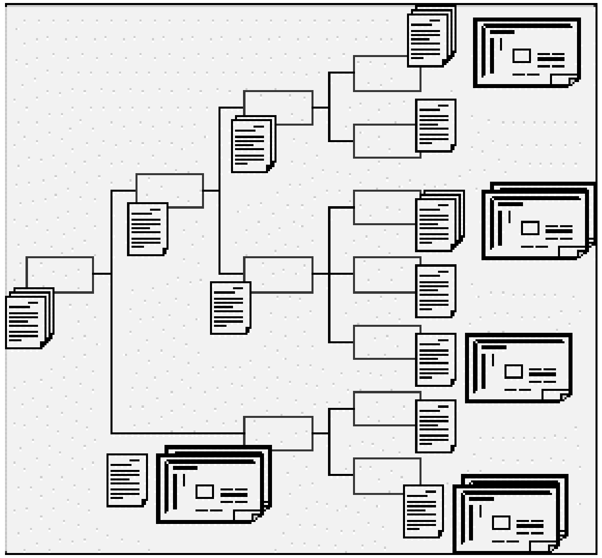
The tool used for document management is the ENGINEERING DATA MANAGEMENT SYSTEM

EDMS provides:

Storage
Approval
Distribution

Structure
Classification





QAP related documents

ATC-OQ-QA-2030	Document Identification System
ATC-OQ-QA-2034	Document Types
ATC-OQ-QA-2020	Document Standards

TRACEABILITY: OBJECTIVES

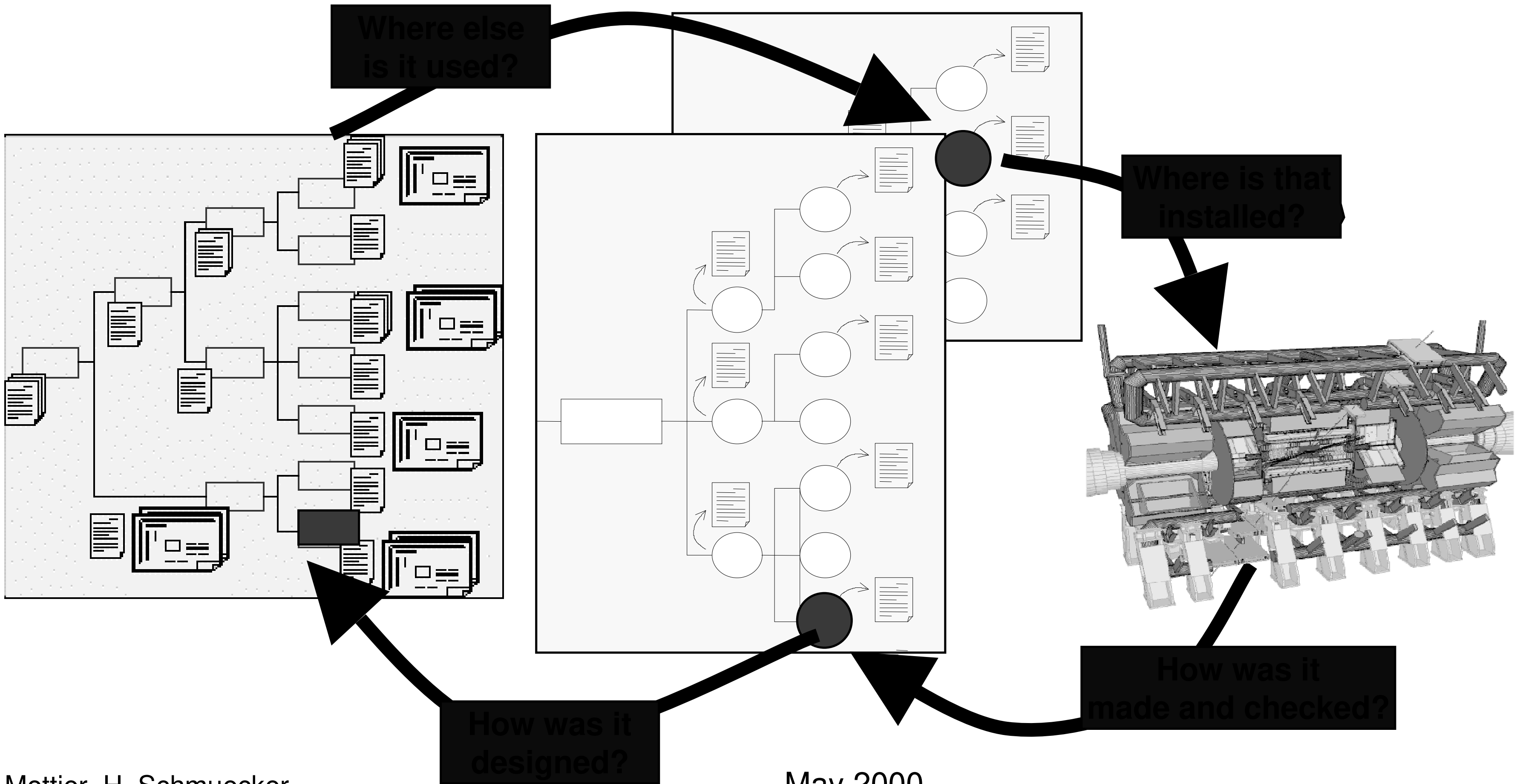
Traceability is the ability to trace the history,, application, and location of a product by means of recorded identifications. Achieving traceability means being able to follow the life of a product, in particular:

- **the origin of materials and parts**
  - **WHAT it is made of**
- **the processing history**
  - **HOW it was made**
- **the distribution and location of the product after delivery**
  - **WHERE it is used**

TRACEABILITY: AN EXAMPLE

PBS
Design documentation

ABS
Manufacturing/ Assembly documentation



CONCLUSION

With the QAP and the EDMS we have a very useful way to ensure the entire orchestra is working from the same arrangement. It does not, by itself, ensure a good performance, but it does ensure the basic conditions to make the good performance possible.

The quality of the performance itself depends on the individual persons. If we all play to the same tune, the result will be excellent.

So, let's tune our violins, balalaikas, bagpipes and play!