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# CERN Alarms Data Management: State and Improvements

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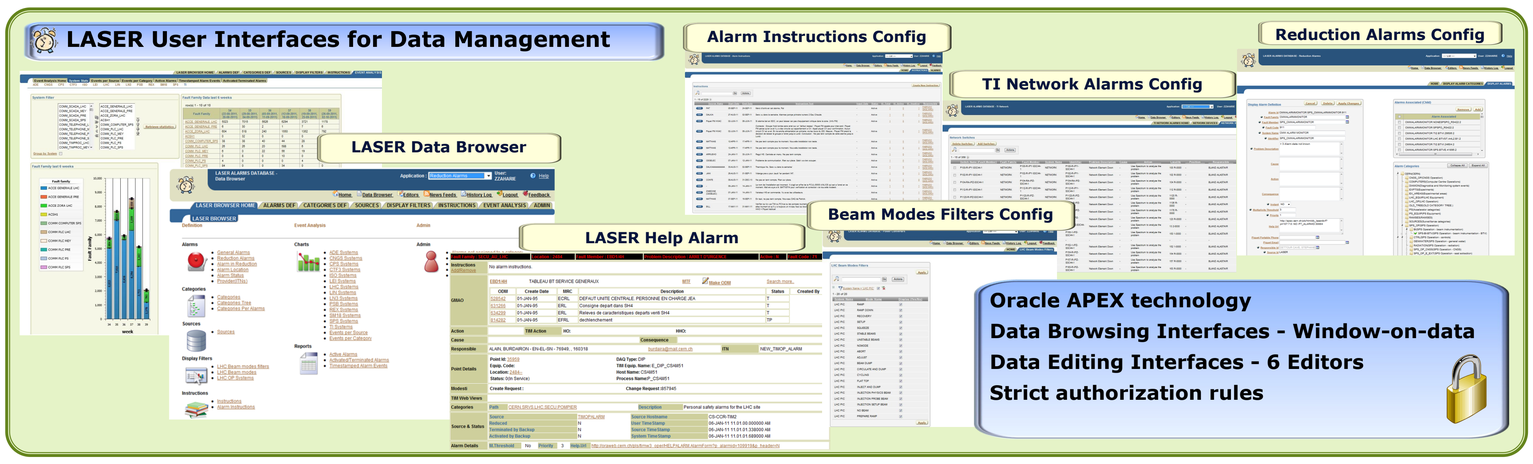
**Abstract**

The CERN Alarms System - LASER is a centralized service ensuring the capturing, storing and notification of anomalies for the whole accelerator chain, including the technical infrastructure at CERN. The underlying database holds the pre-defined configuration data for the alarm definitions, for the Operators alarms consoles as well as the time-stamped, run-time alarm events, propagated through the Alarms Systems.
The article will discuss the current state of the Alarms database and recent improvements that have been introduced. It will look into the data management challenges related to the alarms configuration data that is taken from numerous sources. Specially developed Extract-Transform-Load (ETL) processes must be applied to this data in order to transform it into an appropriate format and load it into the Alarms database.
The recorded alarms events together with some additional data, necessary for providing events statistics to users, are transferred to the long-term alarms archive.
The article will cover as well the data management challenges related to the recently developed suite of data management interfaces in respect of keeping data consistency between the alarms configuration data coming from external data sources and the data modifications introduced by the end-users.

## LASER User Interfaces for Data Management




Oracle APEX technology
Data Browsing Interfaces - Window-on-data
Data Editing Interfaces - 6 Editors
Strict authorization rules

## Operations Alarms Consoles

## LASER Service Middle-tier

## CERN Public DB Cluster—General Purpose Network

**Alarms Config DATA COLLECTION**

⇨ Data representing 31 alarms data domains

⇨ Standard format of interface tables

Data Import

**Alarms Config DATA VALIDATION**

⇨ Intensive 2-stage ETL process with complete data validation

Data Upload

## LASER Cluster—Technical Network

ORACLE RAC Cluster

| Database Statistics | |
|---|---|
| Tables | 207 |
| Constraints | 241 |
| Lines PL/SQL code | 32,000 |
| Volume | 195GB |

**LASER CORE**

⇨ User's display configurations data
: Filtering criteria, based on beam modes, etc.
: Reduction display alarms configuration

⇨ Short-term archive
: Run-time time-stamped events data
: Last 6 months of data
: 250 sources
: Average of 170,000 events/day
: Peaks of 1000 events/second

⇨ Alarms definitions configuration data
> 3 million data elements

Data Archiving

**LONG-TERM ARCHIVE**

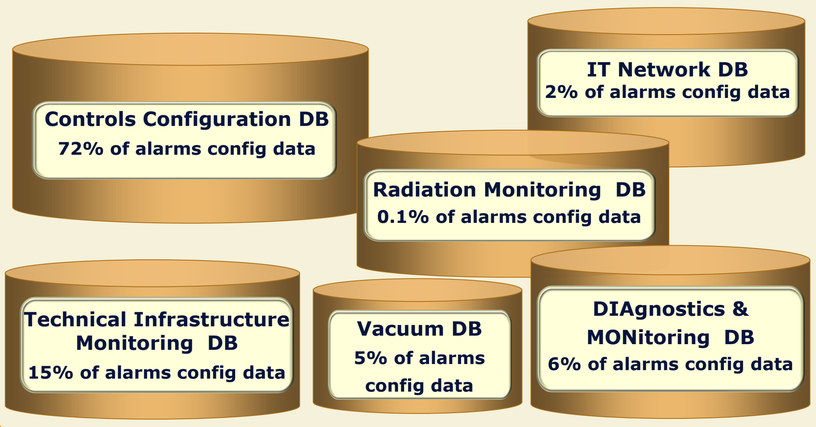
⇨ Archiving of the previous year data once per year

⇨ PL/SQL code with reduction of the data factor of 10

⇨ Since 2005

⇨ Stored between 4 to 10 GB/year archived data

## Alarms Configuration Data—streamlining of data providers



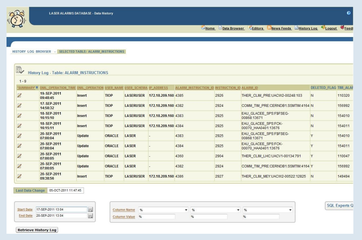

**LASER Service Middle-tier**
**JMS**
**LASER Source APIs**

## Data Security

⇨ Audit every session opened in the LASER CORE db account

⇨ *Since 2009* record of *who* changed *what* data and *when*

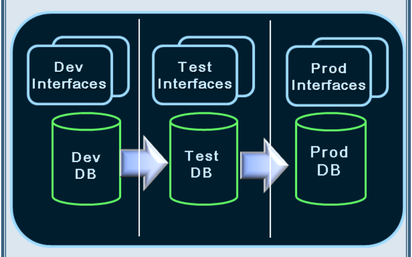
⇨ History Log Browser for Alarms configuration data



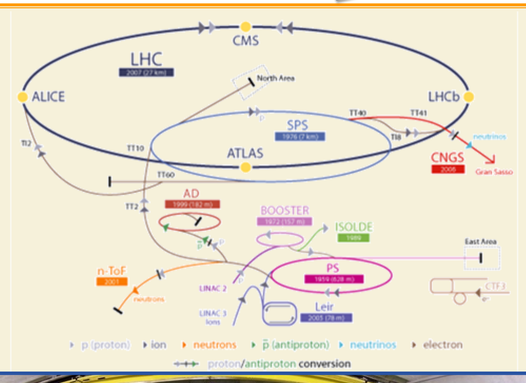
## Service Quality Assurance

⇨ Testing and Development Environments

⇨ Test environment introduced in 2010




## CERN Accelerator Complex

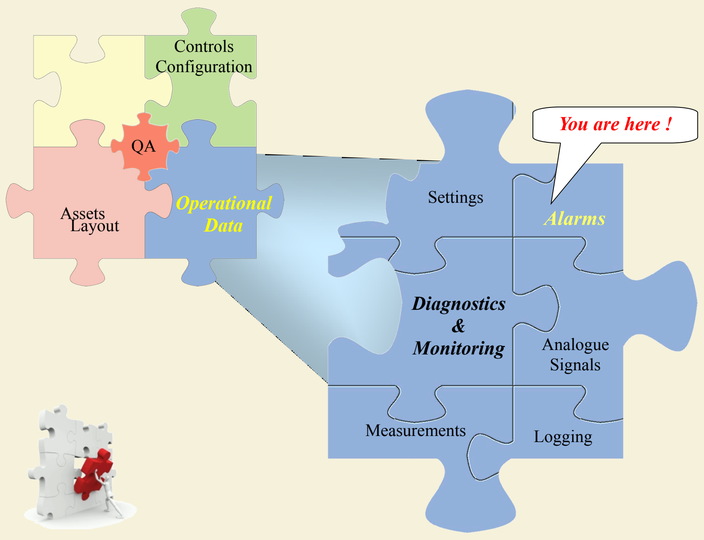





## Alarms Data Domains (ITNs)

⇨ Access control
⇨ Beam transfer systems,
⇨ Beam diagnostics systems
⇨ RF systems
⇨ IT computer surveillance
⇨ Radiation monitoring
⇨ Power converters,
⇨ Vacuum system,
⇨ Beam interlock systems
⇨ Powering interlock systems
⇨ Warm interlock systems
⇨ Software interlock systems
⇨ Cooling and ventilation
⇨ Cryogenics
⇨ Quench protection system
⇨ CERN electrical grid
⇨ etc.

## Data Management Domains




## Conclusion

The Alarms Service is a critical element, which is indispensible to the Operation of CERN's accelerators complex. The database tier plays a pivotal role and has proven to be a stable and reliable component. Continuous effort is put into its improvement through rationalization, data federation and development of new functionality at the database and interfaces level.
A new LASER Core database model is in the process of being developed catering for additional data elements for the alarms quality management and a workflow for the operators to approve the alarms configuration data.
A significant challenge in the future of the Alarms data management will be the smooth transition between the existing database model and ETL processes and the new ones to support the renovated LASER service.

## References

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[7] Z. Zaharieva, R. Billen, "Rapid Development of Database Interfaces with Oracle APEX, used for the Controls Systems at CERN", ICALEPCS'09, Kobe, Japan, Oct-2009, THP108.