

# OVERVIEW OF ‘THE SCANS’ IN THE CENTRAL CONTROL SYSTEM OF TRIUMF’s 500 MeV CYCLOTRON

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# ABSTRACT

The Controls Group for TRIUMF's 500 MeV cyclotron developed, runs and maintains a software application known as The Scans whose purpose is to

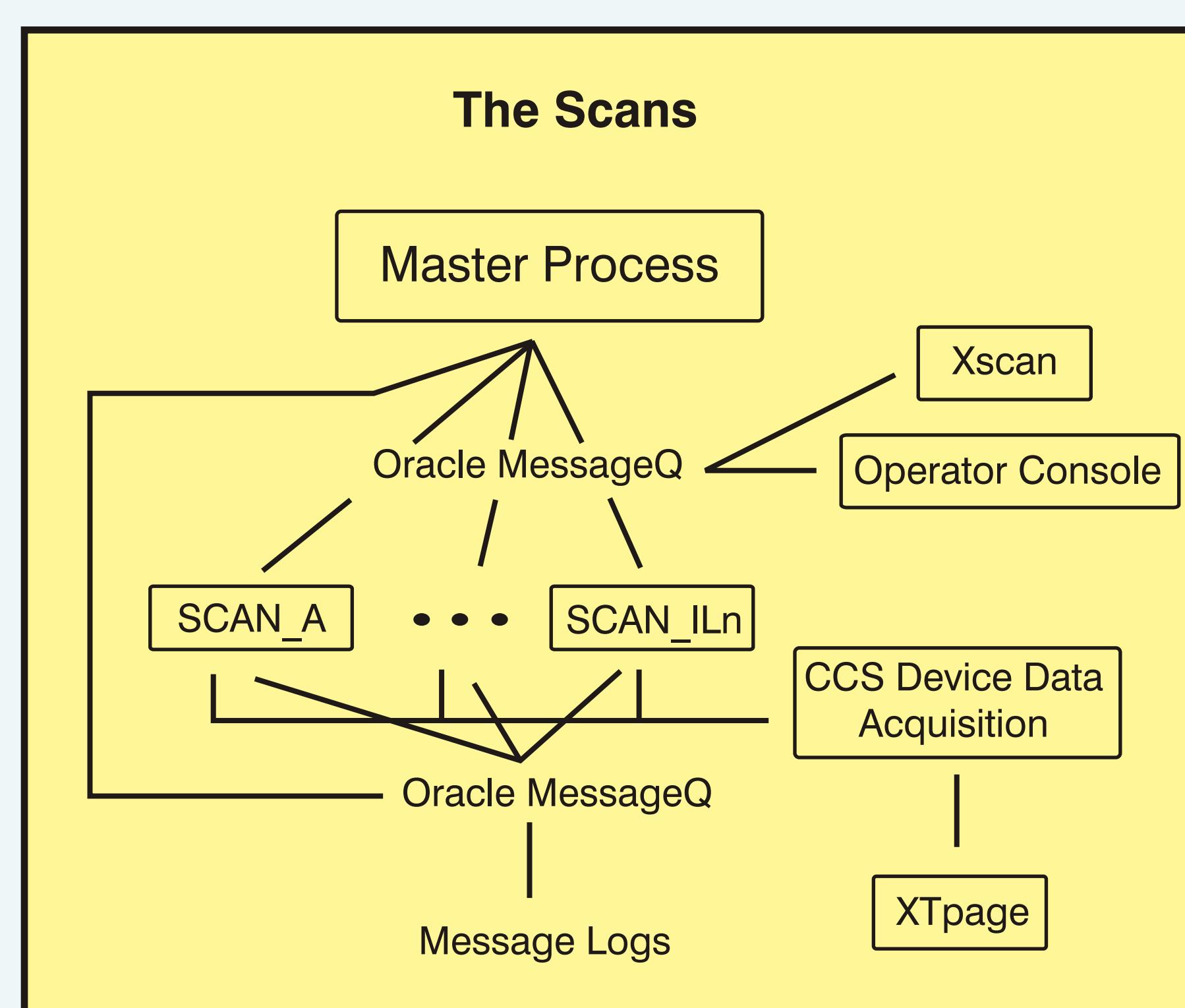
- 1) log events,
  - 2) enunciate alarms and warnings,
  - 3) perform simple actions on the hardware, and
  - 4) provide software interlocks for machine protection

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Since its inception more than 35 years ago, The Scans has increasingly become an essential part for the proper operation of the Cyclotron.

This paper gives an overview of The Scans, its advantages and limitations and desired improvements.

# INTRODUCTION

- More than 35 years since the first version
  - Has undergone significant evolution
  - One of the primary software utilities in the Central Control System
  - An essential component
  - Performs a wide variety of actions such:
    - Provides machine protection (beam trips and “soft” trips) and warnings
    - Diagnostics
    - Initializations
    - Watchdog monitoring
    - Event notification (messages to activity logs)
    - Automatic resetting of equipment
    - Dynamic adjustment of gain settings to avoid saturation
  - Typically more than 50 active scans and more than 4500 active scan elements
  - Regularly produces several thousand event messages a day from scan elements
  - Runs 24 hours a day, 7 days a week, even during shutdowns when possible



## Primary Application Components of The Scan

# PERFORMANCE

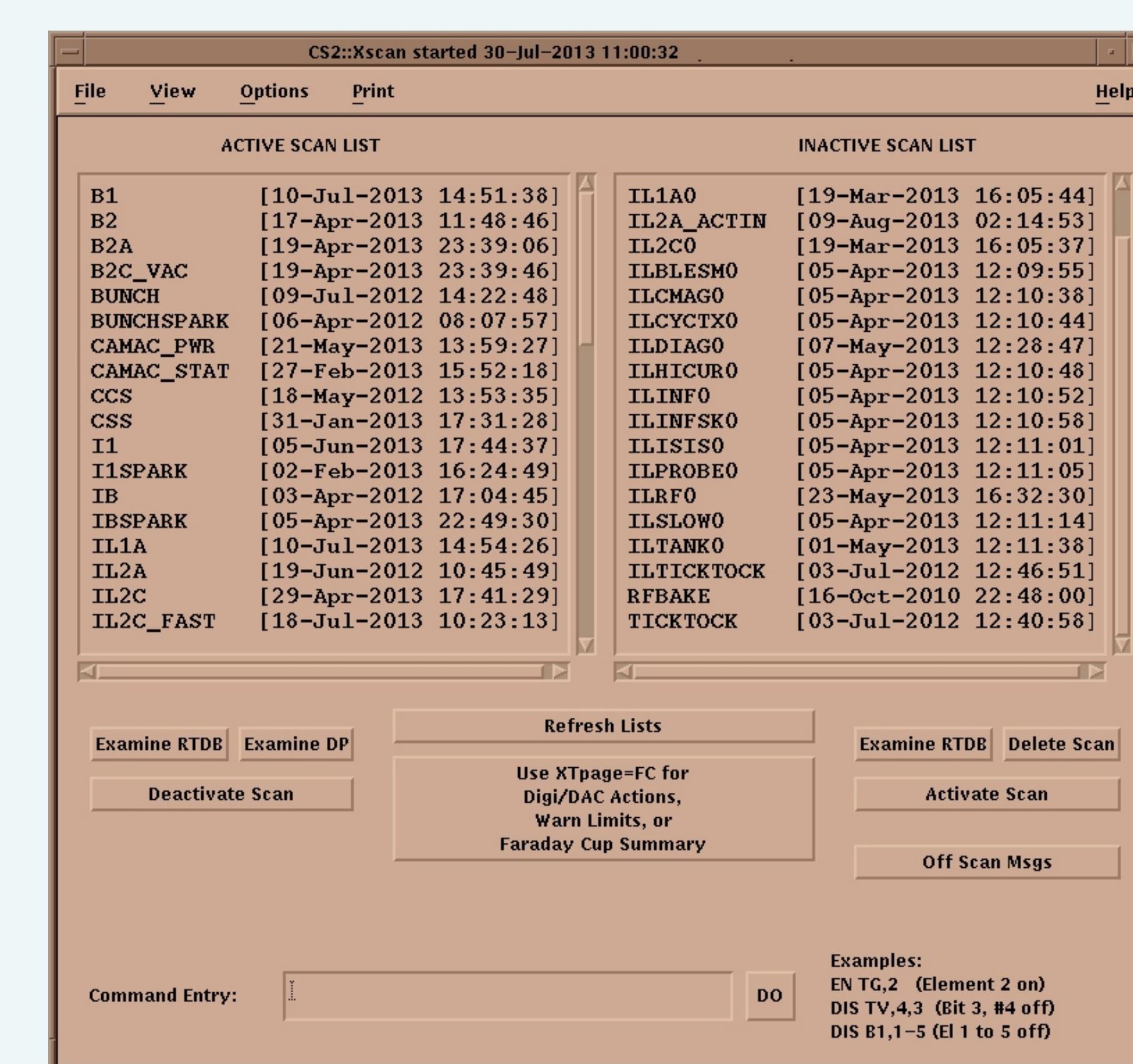
- Executable code runs in one server, GUI runs across clusters
  - Takes a minor fraction of a server, ~ 2%
  - Can have message storms, actions taken to minimize the storms

# FEATURES

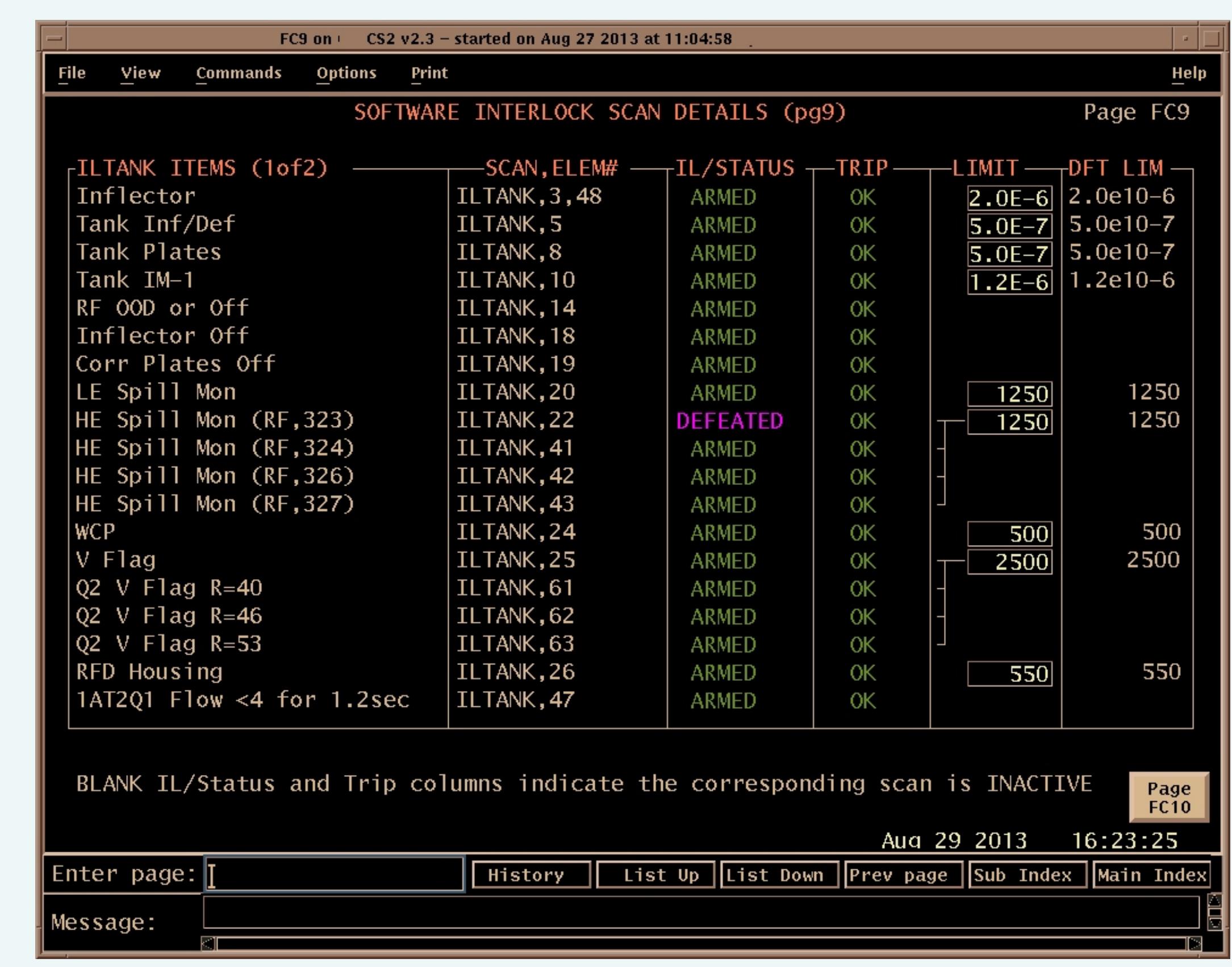
- Selectable scan rate for efficiency, where each list has its own rate (presently 10Hz to 1 per minute)
  - Inter-process communications:
    - Exports internal states (last trip status, defeats, scan active) and data
    - Listens for commands and takes actions
  - Defeats (by disabling a bit, an element, or whole scan)
  - Multiple actions per scan element
  - Efficient, relatively simple
  - Scripts are easy to read; uses keywords
  - GUI, supports multiple active instances
  - Exported data/status allows other apps to display data
  - Scalable; more scans can be added, more elements can be added
  - Temporary variables

**Typical example of a scan element:**

ELEMENT 8: ENABLED,ACTIONS: 4, NO\_AUTODISABLE  
TV,56,MUX < 1.1E-9 OR TV,56,MUX > TK,531,MUX  
DO INSERT FARADAY CUP  
DO LOG opslog "CORRECTION PLATE TRIP: VACUUM"  
DO CALC TEMP(90) = 15 \* 65535 + 101  
DO WRITE TEMP(90) TO ET.100.DAC



# Xscan - User interface to The Scans

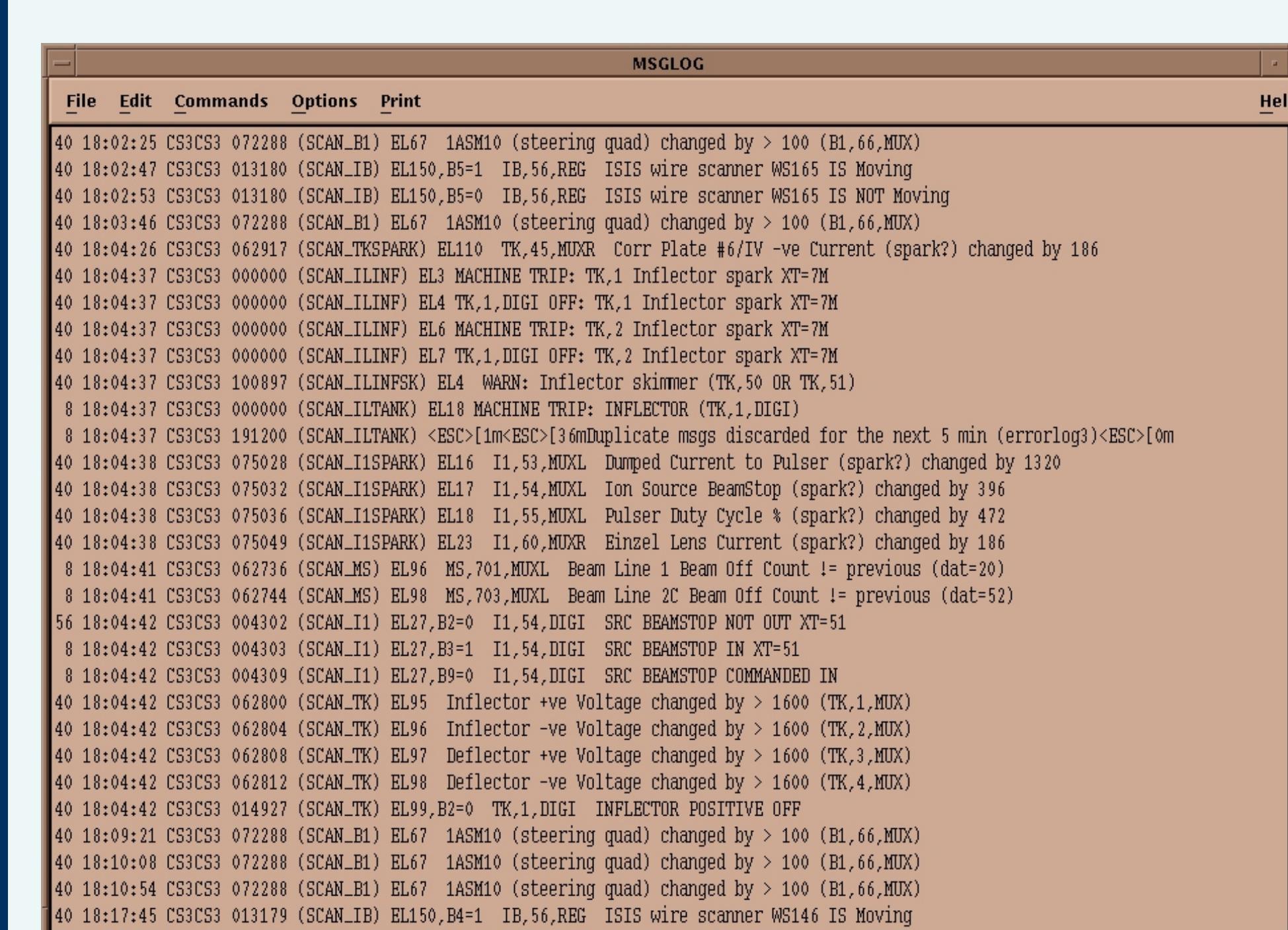


## XTpage display of an interlock scan

# OPERATIONAL EXPERIENCE

- Easy to understand and to interact with
  - Has provided many instances of machine protection
  - Essential for running beam
  - Reliable
  - New elements get added every week or so

Messages generated by The Scans are helpful for forensic analysis



## Sample messages logged by The Scans

# DESIRED ENHANCEMENTS

- Additional Xscan display features
  - Save/Restore the enable/disable state of individual scan elements
  - Quick, short-term, user defined scans with audible alarms and message generation (mainly for Operations)

# SUMMARY

- A useful, easy-to-use, easy-to-modify, scalable, robust application
  - Has evolved over more than three decades to be an essential part of the Cyclotron's Central Control System
  - Runs reliably and efficiently
  - Useful in a variety of areas such as machine protection (warnings, hard and soft trips), event logging, diagnostics, and device initialization
  - Functionality has increased from providing basic interlock protection and logging to finer actions like setting the proper gain on devices and iteratively/adaptively reducing beam intensity (soft trips)