

COMPUTER-BASED LOGGING - SIMPLIFYING STATION LOG PREPARATION, ACCESS AND USE

E. Davey *, M. Thompson and R. Basso
Control Centre Technology Branch
AECL, Chalk River Laboratories
Chalk River, Ontario, Canada K0J 1J0

K. Herzog, L. Lane and R. Chatterton
Operations, Darlington Nuclear Division,
Ontario Hydro, Bowmanville, Ontario, L1C 3W2

* Now with Crew Systems Solution, Box 859, Deep River, Ontario, K0J 1P0

ABSTRACT

A computer-based application for preparing and reviewing records of shift activities (i.e., logs) has been developed for CANDU station use. This application was developed with extensive participation of Operations staff at Darlington and several other CANDU stations, incorporates the lessons learned from previous station electronic logging experience, and was guided in development by the application of human engineering principles. Use of the application is expected to simplify and improve log preparation, search of log records, and more timely dissemination of log information to plant staff.

This paper outlines the project rationale, reviews key development objectives for the application, discusses the development approach applied, describes key features of the application, and outlines the status of current work leading to station deployment.

BACKGROUND

CANDU operating practice requires the preparation of a number of logs that provide a summary of station operations in specific areas. These logs are prepared by operations staff during each shift and typically contain a record of:

- the major operating actions taken,
- the problems encountered and response taken,
- the maintenance work undertaken and completed, and
- a summary of the plant status at shift turnover.

Many station logs are still prepared using conventional paper-based records prepared in handwritten form. While this approach has proven satisfactory, the introduction of a computer-based logging application offers potential advantages for simplifying and improving:

- log preparation, especially during outages where a large number of log entries must be carried forward from log to log,

- entry of common, repetitive log entries,
- standardization of logging terminology and organization based on the use of a preferred vocabulary of terms and entries appropriate to each log application,
- the search of log records to locate former instances of log entries pertaining to conditions of interest (e.g., SCI entry 43000 - Feedwater),
- timely dissemination of completed logs to specific station Operations, Planning, and Maintenance personnel to improve their awareness of unit configuration and operations, and
- accessibility of completed logs by surveillance and analysis staff.

In 1997 January, Darlington Operations and AECL staff began the development of an electronic logging application under CANDU Owners Group (COG) sponsorship. The COG scope of work involved the development of the functional and performance specifications for a software application that could be applied to support all station logging needs. The specification produced consists of two parts:

- a report describing the functional and performance requirements, including a description of the proposed application concept (1), and
- a logging application prototype used to demonstrate and evaluate the user-interface behaviours of the proposed application.

While the primary development work was focused at Darlington, interest in the application grew, resulting in Operations staff at several CANDU stations contributing to development and assessment activities. Due to the widespread endorsement by Ontario Hydro Operations staff, the prototype application has been accepted as the model for engineering development of electronic logging applications for Ontario Hydro station use and for incorporation in future AECL CANDU station designs.

DEVELOPMENT OBJECTIVES

At the onset of the development program the following key objectives were established to guide application development:

- A single application shall be capable of supporting all station logging needs.
- The application shall support current station logging practice as defined in station procedures (2) and utility standards (3).
- The electronic log shall be designed to remain open and accessible at all times until closed at the end of the shift.
- Entry of single log entries shall take no more effort and time than the equivalent handwritten log entry.
- The effort and time to prepare a summary log at the end of a shift shall be reduced by a half for normal operations and by a factor of four for outages.
- All log entries shall be editable until shift turnover. At shift turnover, all log entries shall be locked.
- Logs in preparation and previously completed logs shall be electronically accessible to station staff on a read-only basis to better support planning, surveillance, and investigative tasks.

APPROACH

The application was developed employing a 'user-centered' design model. This involved participation of representative users on the development team, the definition of requirements based on user functional and performance task needs, and use of a series of application prototypes to proof-test and refine application features. Development staff met with station Operations staff on a regular basis to observe current station logging practices, demonstrate and evaluate proposed application features, and discuss development direction and priorities.

During 1997, the functionality and performance of the application was refined through four prototypes. Assessment of the application has taken two forms. Informal evaluations and trial usage of the application has been undertaken with Operations staff at several stations. This has been facilitated by station demonstrations of the application by the development team, periodic publication of a project newsletter, and regular distribution of application updates to interested users.

A formal evaluation of the prototype application was conducted with Darlington Operations staff in the summer and fall of 1997 (4). The objectives of this evaluation were to:

- Identify application features requiring further improvement,
- Identify opportunities for further logging task simplification, and
- Confirm aspects of the preferred control room implementation strategy.

Key findings from this evaluation included:

- Overall, Operations staff judged the application to be an adequate replacement for current handwritten logging practice,
- The use of a library of pre-defined message components simplified and standardized log preparation, and enabled customization of the application for specific logging needs,
- An organization of messages by only major System Names and SCIs (e.g., Moderator - 32000) was found to limit logging expression and specificity. An organization Section Names and SCIs based on the station Operating Manual index was suggested as a more suitable alternative, and
- For control room operator use, an implementation based on the use of a dedicated laptop computer with periodic update of current log information to a LAN-based database was confirmed as the best way to meet all user needs and address backup and fault tolerance concerns.

The application specification has also been assessed against the recently issued Ontario Hydro standard for Operations Narrative Logging and found to be compliant (4).

APPLICATION DESCRIPTION

In order to most effectively meet a number of station logging needs, the application was designed as a general purpose application with a configurable information component. This allows all station staff to use the same interface but permits the information content to be customized for each logging application. This permitted a consistent interface to be used across all station logs simplifying user learning and technical support.

The logging application consists of a series of displays that mimic the log record sheets currently in use. Selection of displays and application features is accomplished via drop down menus and display button selections.

Creation of log entries is a two step process:

- Selection of the Relevant Log Section Name or SCI:

The Log Section Name and SCI for the entry (e.g., Condenser - 42000) are selected from a predefined list of Section Names and SCIs customizable to each to each logging application. The user is free to organize the Section Name and SCI list alphabetically by Section Name or in numerical order by SCI to best suite personal selection strategies.

- Entry of the Log Message:

The message can be selected from a predefined list of common messages for the Section Name/SCI selected, or entered manually via a keyboard entry. Examples of predefined messages to support control room operator logging are shown in Table 1.

Each message entry is automatically timestamped and stored in a local database. In the future, all database entries will be periodically uploaded to a network server for archival and immediate access by other station personnel on a read-only basis.

Examples of the display layout for the Chronological and Shift Summary portions of a control room operator log are shown in Figures 1 and 2.

Creation of new logs is limited to authorized users under administrative password control. Completed logs are accessible on a 'read-only' basis to station staff with LAN access.

The electronic logging application was designed to match the existing suite of commercial desktop applications currently in use at most stations (i.e., the Microsoft Office suite). This approach applies interface conventions and behaviours from common applications that are well known by users with the expected benefits of reduced user learning time and support costs.

For the prototype, the two components of the application were implemented with two mainstream software products:

- User Interface - Microsoft Visual Basic (i.e., Version 4.0) and third party software enhancements, and
- Database - Microsoft Access (i.e., Version 7.0).

The application is designed to function in the Microsoft Windows 32-bit environment under Windows 95, Windows NT 3.51 and Windows NT 4.0.

DEVELOPMENT STATUS

Development and refinement of the basic application features to support log preparation, selection and review is complete. Within Ontario Hydro, work is underway to define an engineering development program and supporting station deployment activities. AECL also is planning to implement a version of the logging application in future CANDU control rooms. Future work under COG sponsorship will likely address four needs:

- Support to Ontario Hydro and AECL groups undertaking engineering implementation of the application,
- Collaboration with representative users to define message libraries for specific logging applications,
- Further definition of application functionality to better support station staff who routinely read or analyze logs (e.g., searching several logs for specific entries, building reports, automatic forwarding of entries of interest via email), and
- Exploration and evaluation of the operational merits of alternative interface concepts (e.g., pen and voice) for task simplification and enhancement in specific logging situations.

CONCLUSIONS

A specification and working prototype for a robust and effective electronic logging application has been developed for station use. Extensive trial use of the application by Operations staff at several CANDU stations has provided a rich source of refinement suggestions and built user support for the electronic logging concept. Based on this success, the application is being prepared for Ontario Hydro station use and incorporation in future AECL plant designs.

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3. Operations Narrative Logging. Ontario Hydro Nuclear Standard N-STD-OP-0003-R00. Toronto, Ontario, 1997 November 4.
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Table 1: Examples of Predefined Log Messages.

Shift Log Section Name	SCI	Predefined Log Message
Plant Status	00000	Full power steady state: Reactor power xx.x %. Average zone level xx %, CPPF x.xx, Channels fuelled x. Turbine/Generator xxx Mwe, xxx MVars.
Heat Transport	33000	Transferred x.x Mg from TRF to top-up heat transport storage tank x.x m.
Liquid Zone Control	34810	Liquid zone control placed in Special Shutdown mode - AZL xx %.
Fueling	37000	Channel x-xx - Closure plugs removed, Average zone level xx %.
Turbine	41000	Runup completed - Turbine at synchronous speed.
Main Condensate	44000	xxx kg Hydrazine added to hotwell per Chemistry Lab request.
Class 4 Power	50340	Bxx de-energized.
Shutdown System 1	68200	Auto recalibration of all NOPs to RDS xx % completed. Channel x tripped. Selected for SRST xxxxx.
Digital Control Computers	69100	DCC alarm summaries and logs reviewed.
Generic Messages (common to all SCIs)	xxxxx	Deficiency Report #xxxxxxx.

ShiftLog File Edit Tools Window Help

Shift Log: Unit 1 - Authorized Nuclear Operator - 1997/10/29 - Shift 2

Shift Log	Time	Section	SCI	Entry	Sum
Status: CLOSED Entries: 13 Delete Entry Sorted By: Time Filtered By: none	97/10/29 11:30	Boiler Feedwater	43000	LCV101 removed from service.	<input checked="" type="checkbox"/>
	97/10/29 13:45	Fuelling	37000	Channel M-09 - Closure plugs removed, AZL 35 %.	<input type="checkbox"/>
	97/10/29 13:46	Overall Unit Control	60040	Notice received of AECB 55 % power limitation removal.	<input checked="" type="checkbox"/>
	97/10/29 14:35	Fuelling	37000	Channel M-09 - Closure plugs installed, AZL 36 %.	<input type="checkbox"/>
	97/10/29 14:38	HT D2O Collection	33810	Collection tank at 99.62 % D2O. Contents transferred to PHT main circuit.	<input type="checkbox"/>
	97/10/29 14:43	Overall Unit Control	60040	Reactor Power increased to 60 %, AZL 35 % as part of first stage of power increase following 55 % power limitation removal.	<input checked="" type="checkbox"/>
	97/10/29 16:40	Note		AECL COG team installed Shift Log application update (Version B.097.3) to unit laptop and provided instructions in new features.	<input checked="" type="checkbox"/>
	97/10/29 17:49	Digital Control Computers	69100	Deficiency Report # 457920 filed to summarize need for application of annunciation conditioning during upsets and outages.	<input checked="" type="checkbox"/>

Figure 1: Chronological Log.

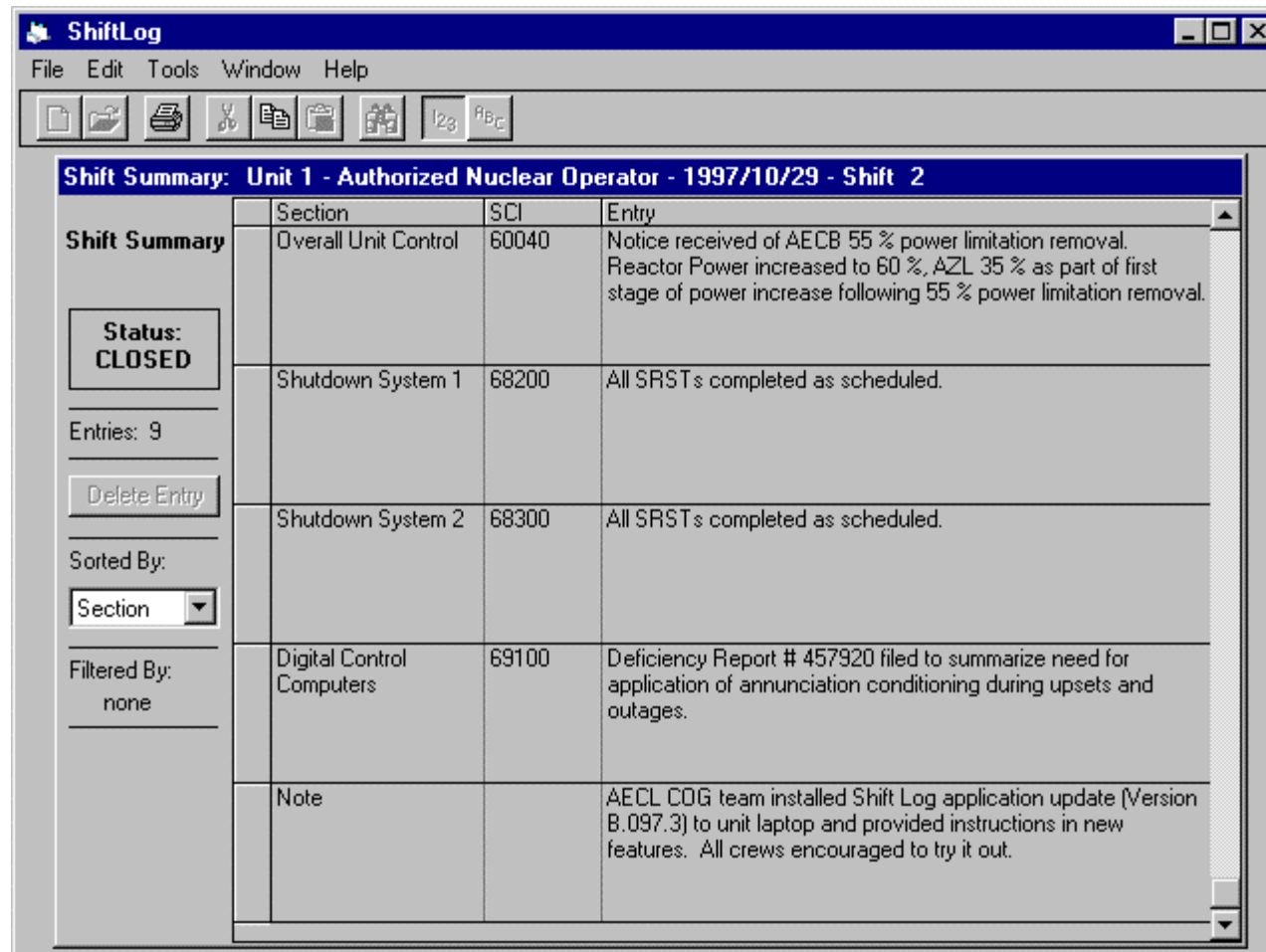


Figure 2: Shift Summary Log.