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WAFER SORT CONTROLLER V2.71 SPECIFICATION

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WAFER SORT CONTROLLER SPECIFICATION

Overview

The Wafer Sort Controller (WSC) is a real-time wafer mapping and prober control system. This generic tool allows the streamlining of the wafer probe production process by adding modern features to existing wafer probers such as; real-time graphical wafer mapping, off-line inking, inkless, real-time production monitoring and controls, and data management tools.

The WSC provides a generic graphical user interface that is independent of the tester and prober type, and is designed to take full control of the wafer probe process providing optimised control maps, increased flexibility, improved productivity and overall efficiency, hence maximising tester utilisation.

Some of the main features and benefits are described in the following sections.

Real-Time Wafer Mapping

The WSC provides a real-time graphical wafer map display of the test results in full colour, with zoom options. Special features can be enabled to overlay the reticle shots and probe card configuration information onto the wafer map to aid in the early detection of process, tester hardware, and probe card problems.

The real-time wafer maps also provide the wafer bin results along with wafer and lot yield and trend information, allowing the user to keep track of exactly how the lot is performing.

Off-Line Inking

The WSC provides flexibility by supporting in-line, off-line and post-probe inking.

In-line inking can be done either during probing or immediately after probing the wafer.

Off-line inking is an important feature to help maximise tester usage. A standalone prober is set-up and used specifically for inking. Firstly, the wafer/lot is set-up and probed via the WSC on the appropriate test station. Once probing is complete the wafer/lot can be transferred to the ink station for inking. The WSC provides the user with an easy to use intuitive interface enabling the automatic set-up and retrieval of wafer/lot results to be used for inking.

Inkless

The WSC offers full integration with Optical Character Recognition (OCR) systems to ensure wafer integrity. Intelligent routines are used to ensure reference die integrity thus enabling the support of inkless wafer sort.

Multi-Site Probing

The WSC supports multi-site probing using the standard linear, rectangular and diagonal configurations.

Multi-site probing is enabled via the product specific control map where the required probe card configuration is defined. The user has the ability to define multi-site differential yield triggers to help identify and give early warning of any test or probe card related problems where there is significant yield difference between sites.

Intelligent Stepping

The WSC provides the option to avoid probe card over-hang during multi-site probing.

Real-Time Production Controls

The WSC provides extensive real-time yield management capabilities in the form of user definable production controls.

The user has the ability to define product specific yield and bin alarms that will trigger when the preset limits are reached enabling corrective action to be taken when these conditions occur, for example; probe tip clean/scrub, re-probe of specific bins, request for operator assistance, etc.

Real-Time Production Monitoring

The WSC provides the ability to monitor in real-time the status of every production system on the network via the Area Status Tool.

The Area Status Tool provides a graphical display listing every test system and ink station on the network and it's status using a traffic light colour-coded format, making interpretation of the results quick and easy.

The Area Status Tool also provides detailed information in relation to the product set-up, test program and hardware in terms of probe card and load board in use on each test system and ink station.

Wafer Thumbnails

The WSC provides the ability to review the wafer map results of all wafers in the lot via the wafer thumbnails feature.

Production personnel can use this feature to check the wafer maps and identify any potential probing problems that may need to be addressed, prior to moving the lot on to the next processing step.

Automation Mode

The WSC provides an Automation Mode option that strictly controls the production setup, enabling the product specific automated download of both the prober and tester based on the lot number, which can be entered manually or via a barcode reader.

Automation Mode not only guarantees the integrity of the production setup but also reduces system setup time which can result in throughput gains. Once the system has been setup it is valid for any subsequent lots of the same product.

The Automation Mode is enabled via the System Configuration Menu.

Navigation Quick Links

The WSC provides the ability to quickly navigate between display modes i.e. colour wafer maps, lot summary, log files and post-probe logs, for the product/lot combination loaded.

This feature enhances the user experience and saves time by removing the need to load the product/lot combination for each display mode of interest.

Product Map Editor

The WSC provides the Product Map Editor to assist the user in creating the product specific control maps that define the wafer layout in terms of; tested die, edge die and areas of blank silicon. Special positions such as the reference die, first die and sample die are easily defined and controlled.

All of the product specific parameters are incorporated in the control map: -

- Wafer Diameter
- Die Size
- Flat Direction
- Reticle Size
- Probe Card Configuration
- Bin Definitions
- Yield Trigger
- Dynamic Bin Triggers
- Multi-Site Differential Triggers

Summary Editor

The WSC provides the ability to edit the wafer/lot summary once probing is complete to enable changes to be made to the good die totals should inspection fails exist or for any other reason good die need to be inked out and the good die count adjusted.

The Summary Editor also provides the ability to interactively modify the 'maverick' wafer yield trigger enabling the user to assess the impact to the shippable wafers, die quantity and lot yield. Any required changes that are submitted, will result in the lot summary being modified accordingly to reflect these.

Die Kill Tool

The WSC provides the ability to downgrade die that for some reason need to be rejected after all previous processes have been completed i.e. wafer probe, AVI and MDE.

The Die Kill Tool enables the user to perform this function off-line or manually on the prober itself.

The WSC enables the user to manually step around the wafer to identify the additional failing die, or use the mouse to 'draw' around the affected area on the wafer map.

The WSC assigns a Bin 0 to identify this particular type of failure and the wafer/lot summaries are updated accordingly.

In addition, should all wafers in a lot be affected with the same problem, a template file can be generated and applied to every wafer.

Session Configuration Tool

Each WSC production system has default configuration settings applied.

However, the WSC provides the ability to customise the configuration settings on a system-by-system basis, should the need arise e.g. wafer check frequency, tester/prober time-outs, by-pass 'maverick' wafer alarm etc.

Quality & Integrity

The WSC supports the use of a Barcode Reader and Optical Character Recognition (OCR), both of which enhance the production process by guaranteeing lot and wafer integrity.

And as mentioned previously, the WSC provides an Automation Mode that not only guarantees the integrity of the production setup but also reduces system setup time which can result in throughput gains.

Another important feature is the ability to define the 'reference die' position at an easily recognisable position on the wafer, providing a visual aid during product set-up and ensuring 'reference die' integrity.

In addition, a wafer level 'maverick' yield trigger can be set such that 'maverick' wafers are highlighted on the lot summary once probing is complete, and the user is given the option to remove them via the Summary Editor.

Lot Summary Barcode

The WSC provides the ability to print the lot number in barcode format at the top of each lot summary sheet.

This feature ensures lot number integrity for lot tracking purposes where barcode scanners are available.

Post-Probe Integration

The WSC provides the ability to integrate post-probe processing in the form of Maverick Die Elimination (MDE) and Automatic Visual Inspection (AVI).

The electrical test results are merged with the results of the post-probe processes prior to ink or in readiness for inkless assembly.

Additional bad die identified by either the MDE and/or the AVI analysis will be highlighted and displayed in white as flashing die. This dynamic feature enables engineers and production staff to review the end result of all post processing before the product is committed for ink, and can be used as a tool to disposition material that has resulted in what is deemed to be unacceptable yield loss.

In addition, the WSC provides the ability for MDE analysis to be performed retrospectively under engineering control where electrical test results can be retrieved from archive. This important feature can be used by engineering to assess the impact of MDE product recipes prior to release or as an engineering tool to investigate problems highlighted at final test.

Data Management

All WSC production systems are networked via the server which is where all of the product specific control maps reside and where all the probe result files are stored i.e. wafer maps, wafer/lot summaries, log files etc. If for any reason the network connection is lost, these files will be stored locally and automatically uploaded to the network once the connection is restored.

Remote monitoring allows the user to access the WSC production systems from any location on the network, and even through the World Wide Web, so long as the appropriate levels of authorisation are met.

Engineering Tools

The WSC provides a number of engineering tools that can be used during test program development, hardware qualification and debug purposes.

Tester Control Panel

The Tester Control Panel can be used to remotely control the tester. It provides the ability to step around the wafer and independently issue commands from the WSC to the tester e.g. Start Test, Read Bin, End Of Wafer and End Of Cassette commands.

The user can select the die they wish to test by clicking the required die on the wafer map and the prober will automatically move to the selected die and Z-up. The die will flash white to help the user keep track of where they are on the wafer and the XY co-ordinates are also displayed in the bottom left hand corner of the display.

The Test-Bin button enables the user to repeatedly test a die and read the resulting bin number. This can be setup by entering the number of test cycles plus any required delay in milliseconds. This feature is useful when performing gauge R&R studies.

Prober Control Panel

The Prober Control Panel can be used to remotely control the prober. It provides the ability to independently issue commands from the WSC to the prober e.g. Load, Unload, Auto Align, Profile, Lamp On/Off, Chuck Up/Down, and Fire Inker.

Lamp Pole Panel

The Lamp Pole Panel can be used to remotely control the prober lamp pole. The maintenance engineers use this tool, as it provides a quick and easy means to debug any new cables.

Cycle Prober Tool

The maintenance engineers can use the Cycle Prober Tool to set-up the wafer handling, burn in and qualify the prober after maintenance, or for general debug purposes.

The user can select the appropriate Prober Commands to be exercised and enter the required Number Of Cycles, then select Start. The WSC keeps track of the Cycles and Times and displays them in the top right of the panel.

Equipment & Systems Integration

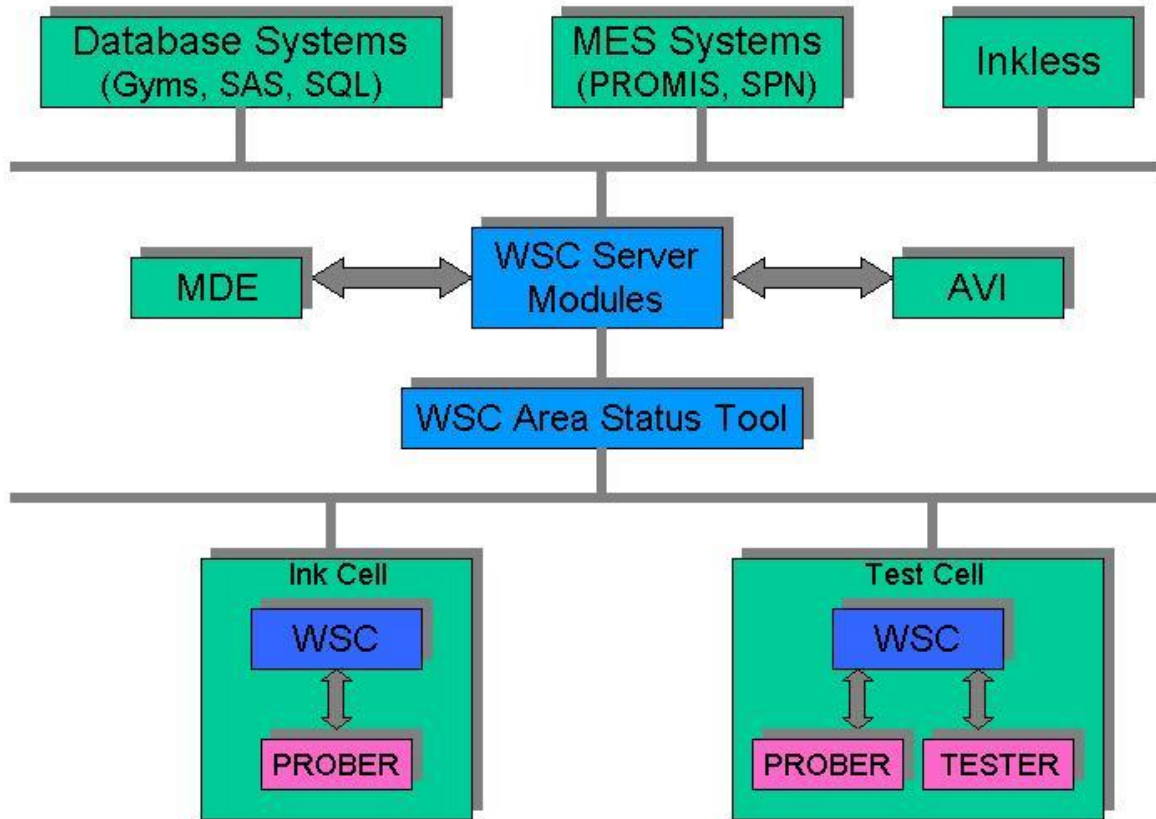
The WSC can be integrated with any tester/prober combination and can be configured to integrate with any corporate databases and/or MES systems.

The following table shows the extent of the current hardware integration.

TESTERS	PROBERS
Advantest	EG4090
Credence	EG2001
EagleTest	EG2010
Epro	EG2080
FETtest	EG4060
LTX	EG4080
Nextest	Accretech UF200
Spea	Accretech UF3000
Tesec	TEL P8
Teradyne	TEL Precio Octo

WSC System Architecture

The diagram below details the WSC system architecture.



AREA STATUS TOOL SPECIFICATION

Overview

The Area Status Tool displays the real-time status of every WSC production system on the network and uses a colour-coded traffic light system enabling the user to quickly assess activity on the production floor.

The Area Status Tool can be configured in either Engineering or Production mode, with the Production option set-up to focus on Production metrics and provide time and motion data. This data is extremely useful for capacity planning and in the understanding of why targets have not been met due to unforeseen problems.

The Area Status Tool provides the ability to configure and group systems into cells, this is reflected on the Area Status display where the user can choose to view all cells or particular cells of interest.

The Area Status Tool also provides the ability to 'drill-down' to any WSC production system on the network and view all system activity in real-time. This extremely powerful feature allows engineering and production personnel to remotely monitor any system of interest from their desk, enabling them to see exactly what the operator running the system can see as if they were attending to the system themselves.

Engineering Mode

When the Area Status Tool is configured for Engineering mode, the WSC production systems are grouped together and displayed in order of priority as described below.

- 1. Red**
These systems are displayed at the top since a red entry indicates that the system is alarming and requires attention.
- 2. Yellow**
These systems are displayed next since a yellow entry indicates that the system is paused while an alarm is being attended.
- 3. Cyan**
These systems are displayed next since a cyan entry indicates that the system is set-up awaiting a new lot.
- 4. Green**
These systems are displayed next since a green entry indicates that the system is running without any problems.
- 5. White**
These systems are displayed at the bottom since a white entry indicates that the system is not being used.

This display makes it very easy for engineering and production personnel to assess the status and activity of every system on the production test floor, immediately highlighting what systems require attention, thus increasing efficiency and productivity.

The operating metrics are displayed in real-time, alongside each system entry, as described below.

Tester

This field displays the tester type and number.

Status

This field displays the system status e.g. probing wafer, aligning wafer, inking wafer, bin trigger fail, auto-align fail etc.

Last Update Time

This field displays the last time a status update was available for the particular system.

Product

This field displays the name of the product being processed.

Lot No.

This field displays the lot number being processed.

Wafer

This field displays the wafer number being processed.

Test Program

This field displays the name of the test program being used.

Part Description

This field displays the user defined product description.

Prober

This field displays the prober type and number.

Probe Card

This field displays the probe card id.

Load Board

This field displays the load board id.

Product Recipe File

This field displays the product recipe file being used.

Cassette No.

This field displays the cassette number being processed.

Slot No.

This field displays the cassette slot number being processed.

MES ID.

This field displays the tester type and number as defined in the MES database.

Lot No

This field displays the lot number being probed/inked.

Production Metrics

The production metric fields are displayed in order as described later.

WSC Revision

This field displays the revision of WSC being used.

Production Mode

When the Area Status Tool is configured for Production mode, the WSC production systems are grouped together and displayed in order of priority as described previously.

Alongside each system entry, the production metrics are displayed in real-time, with time-associated metrics displayed in hours, minutes and seconds, as described below.

Wafer Status

This field displays the status of the lot in terms of the number of wafers probed, the number of wafers remaining to be probed and the current wafer number being probed.

The format of this data is as follows: -

13 / 12 (14) i.e. 13 wafers probed / 12 wafers remaining (14 current wafer number)

Time Remaining

This field displays the estimated time remaining for the wafer and the lot, in hours, minutes and seconds.

The format of this data is as follows: -

0:04:08 / 3:41:29 i.e. 4m 8s wafer time remaining / 3hrs 41m 29s lot time remaining

Total Wait

This field displays the current total wait time, which is the total of ALL potential wait times, in hours, minutes and seconds.

Alarm

This field displays the accumulated time taken to respond to an alarm, in hours, minutes and seconds i.e. all RED entries.

Pause

This field displays the accumulated time that the system has been in a paused state, in hours, minutes and seconds i.e. all YELLOW entries.

Wafer Check

This field displays the accumulated time taken to respond to a wafer check, in hours, minutes and seconds.

OCR

This field displays the accumulated time taken to respond to an OCR fail, in hours, minutes and seconds.

Bin Trigger

This field displays the accumulated time taken to respond to the bin trigger fail message window, in hours, minutes and seconds.

D Bin Trigger

This field displays the accumulated time taken to respond to the dynamic bin trigger fail message window, in hours, minutes and seconds.

Ocap

This field displays the accumulated time taken to respond to an Ocap, in hours, minutes and seconds.

Prober Alarm

This field displays the accumulated time taken to respond to a prober alarm, in hours, minutes and seconds.

Datalog Wait

This field displays the accumulated time taken for the tester to generate the datalog, in hours, minutes and seconds.

Datalog Alarm

This field displays the accumulated time taken to respond to the datalog alarm error message window, in hours, minutes and seconds.

Set-up Time

This field displays the time taken from system set-up i.e. when the prober is loaded (CYAN entries), to the start of the first wafer, in hours, minutes and seconds.

Wafer Time

This field displays the average wafer probe/ink time, in hours, minutes and seconds i.e. with all pause and alarm times removed.

MH Time

This field displays the average material handling time, in hours, minutes and seconds i.e. with all pause and alarm times removed.

WSC SERVER TOOLS SPECIFICATION

Overview

The WSC Server Tools enable the administration of the WSC network and all WSC production systems on the network, providing the ability to remotely manage all aspects of server administration, configuration, and synchronisation.

The WSC server model supports up to 3 servers to provide redundancy in high volume production environments, where each server is configured to be exactly the same. A configuration file that resides on each server is used to determine the server's role when the various scheduled jobs are run.

The server that is configured as the primary handles all data collection and processing functions, whilst the secondaries simply keep in-sync with the primary such that should the primary fail, they are ready and can easily be promoted.

The server tools are accessed via the 'WSC Console' utility, which provides the user with a colour-coded graphical display of the WSC network and the status of each of the servers. This colour-coded display enables the user to immediately identify any problems that exist and initiates a more detailed and focussed investigation should that be required.

The various server tools are categorised and described in the following sections.

Processing Log Files

The Processing Log Files are weekly files that contain details of all file processing and network activity between the WSC servers and the WSC production systems on the network, and the registered database systems.

These files are date and time stamped and can be used by the system administrator in the event of a problem to quickly and easily identify the root cause.

User Log Files

The User Log Files contain details of all user activity for the processing of a lot.

There is a User Log File for each lot and they are named according to the lot number. These files can be used for traceability purposes and can be useful when investigating mis-processing issues.

Storage Instruction Tool

The Storage Instruction Tool provides the system administrator with the ability to define customer specific storage instructions for their products. The specific storage instructions will be printed on the wafer/lot summary that gets packed and shipped with the product.

Server Status Tool

The Server Status Tool provides the system administrator with the details of the entire file processing activities of the server modules.

Various modules are run via the windows scheduler to process the data collected from the WSC production systems on the network.

The Server Status Tool displays the status of these key jobs along with the contents of the working folders that each job is responsible for, thus allowing for the quick diagnosis of any problems.

User Check Tool

The User Check Tool allows the system administrator to monitor the 'User ID' function on each of the WSC production systems on the network and provides the ability to enable or disable this option on a system-by-system basis.

The 'User ID' function, if enabled, requires that the operator enter their unique ID at key stages in the test operation, thus providing full traceability of all actions and decisions made, promoting accountability and providing data that can be used to highlight and identify any training issues of probe area personnel.

Release Tool

The Release Tool provides the ability to manage and control the release of test programs, product recipes, the WSC application itself and all other WSC utilities and files.

This tool enables management and administration on a system-by-system basis, providing full flexibility for engineering and full production releases and the support of beta testing.

Server Synchronisation Tool

The Server Synchronisation Tool provides the system administrator with the ability to add a new server and synchronise it with the primary.

Once the initial synchronisation is complete, the new server will automatically keep in-sync with the primary such that should the primary fail, it is ready and can easily be promoted.

Database Configuration Tool

The Database Configuration Tool provides the system administrator with the ability to configure the customer specific databases in terms of their unique network address, login information and working folders that are used for the storage of WSC data files related to the test results of each wafer e.g. datalogs, bin maps, etc.

Manufacturing Execution System (MES) Configuration Tool

The WSC provides the capability to connect directly to MES systems. The MES Tool allows the system administrator to set-up and configure the connection information to enable the transfer of test data and other related information via automated functions from each of the WSC production systems.

Automated Visual Inspection (AVI) Registration Tool

The WSC supports automated visual inspection post-processing. The AVI Tool provides the system administrator with the ability to register and manage the products that require automated visual inspection, enabling the set-up of product specific parameters that are to be applied during the AVI process and those used to determine the outcome of this process step.

Maverick Die Elimination (MDE) Registration Tool

The WSC supports maverick die elimination post-processing. The MDE Tool provides the system administrator with the ability to register and manage the products that require maverick die elimination analysis, enabling the set-up of product specific parameters that are to be applied during MDE analysis and those used to determine the outcome of this process step.

WSC POST-PROBE PROCESSING TOOLS SPECIFICATION

Overview

The demands made on semi-conductor manufacturers by their customers and product applications, specifically in the automotive and medical sectors, are such that the manufacturers are being driven to find more effective ways of screening product and filtering out weak and unreliable parts, as early in the manufacturing process as possible. Not only does this result in significant cost savings for the manufacturer, but also and perhaps more importantly it ensures a higher quality product for the customer.

In recent years companies have implemented post-probe processes that are designed to target known fail modes and potential quality issues.

The WSC supports two post-probe processes i.e. 'Automated Visual Inspection' and 'Maverick Die Elimination'.

Automated Visual Inspection (AVI)

The automated visual inspection process is performed on a high throughput machine that visually scans each die against a library of images that have known fail patterns. If a match is found, the die is downgraded into user-defined categories that are representative of particular fail modes.

Once this process is complete, the results are written to a file stored locally on the AVI tool. The WSC server module responsible for processing the data is scheduled to collect the results at regular intervals, extract and merge them with the original wafer test results and make them available for ink or inkless assembly.

Maverick Die Elimination (MDE)

The maverick die elimination process uses product specific recipes to analyse the parametric results of each wafer to determine if the good die identified at wafer probe should be downgraded, if for some reason they are deemed to be unreliable.

The product specific recipes can be developed to filter out statistical outliers along with die that fall within a specific geographical region or 'bad die neighbourhood'.

During the wafer probe process, the WSC collects the wafer datalog files from the tester ready for the WSC server module responsible for processing the data.

The wafer datalog files for products that have been registered for MDE analysis are converted to the industry standard ATDF file format required for the analysis software. The 'MDE Engine' takes care of the conversion process ensuring that only 'clean' files are passed on for analysis thus enforcing data integrity at source.

Should there be any problems during the conversion process, the WSC server module immediately informs and provides recovery information to the production personnel to enable the problem to be corrected at source, before the lot finishes wafer probe and is moved on to the next process step. This minimises rework and promotes consistent set-up of the test systems at wafer probe.

Once each datalog file is successfully converted to ATDF format, it is transferred to the MDE analysis server ready for processing.

The 'MDE Engine' initiates the analysis by sending the MDE server a 'trigger file' containing the required product specific information. Once the analysis process is complete, the results are written to a holding folder on the MDE server.

The WSC server module responsible for processing the data is scheduled to collect the results at regular intervals, extract and merge them with the original wafer test results and make them available for ink or inkless assembly.

Post-Probe Inking

The WSC provides the ability to define product specific yield trigger limits, such that product will go on hold for engineering review should the AVI and/or the MDE post-probe processes cause significant yield loss.

The WSC provides the option for engineering to submit product for reanalysis using different product recipe conditions to assess the impact of changes to MDE parameters, facilitating the turnaround of changes required in the event of shifts in the fabrication process.

These dynamic features enable engineering and production personnel to review the end result of all post-probe processing before the product is committed for ink.

WSC Post-Probe Viewing Tool

As described above, once wafer probe is complete, the WSC passes the test results onto each of the post-probe processes for further analysis, the results of which are merged and any subsequent fails are recorded and downgraded.

The WSC retains the original test results plus the results of each of the individual post-probe processing steps, and provides the ability to load the resulting colour wafer maps for review, highlighting the die that failed subsequently due to the post-probe processing.

In addition, the WSC keeps a full log and archive of all post-probe activity for traceability purposes.

The WSC Post-Probe Viewing Tool enables the real-time monitoring of the post-probe processes, providing visibility and detailed information of the progress of each of the individual stages from start to completion.