Eskom	MAINTENANCE STANDARD	Allocation Centre 38A	Reference Number KSM-LIC-001	Rev 2
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KORC	ACCESS	IMPORTANCE CATEGORY	NEXT REVIEW DATE	DATE AUTHORISED
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DATE 2013-03-31	**DATE** 2013-03-31	**DATE** 2013-09-26

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FCA	ALARA REVIEW	SUPERSEDES
MAINTENANCE MANAGEMENT	NO	KSM-LIC-001, Rev 1 dd. 2006-10-26 FULL REVIEW

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1.0 PURPOSE

1.1 To define the requirements for the maintenance process and the controls to be in existence in order to comply with the requirements of the Nuclear Licence.

2.0 SCOPE

2.1 Applicable to the Maintenance of all plant systems at Koeberg Nuclear Power Station.

3.0 DEFINITIONS AND ABBREVIATIONS

3.1 Definitions

3.1.1 **Acceptance Criteria** – Specified limit of a functional or condition indicator used to assess the ability of a System or Component to perform its design function.

3.1.2 **Activity** – Any work performed in the maintenance, inspection or testing of Systems and Components.

3.1.3 **Controlled Document** – A document that is prepared, reviewed and authorised as defined by regulatory requirements, codes and standards and that is uniquely identified and maintained accurate and current by means of a change control process.

3.1.4 **Failure** – Inability or interruption of the ability of a System or Component to function within acceptance criteria.

3.1.5 **Failure Analysis** – Systematic process of determining and documenting the mode, mechanism, causes, and root cause of failure of a System or Component.

3.1.6 **Grace Period** – The allowable activity float, usually expressed as a percentage, which if exceeded will constitute a non-compliance (previously referred to as the tolerance period).

3.1.7 **Maintenance** – Aggregate of direct and supporting actions that detect, preclude, or mitigate degradation of a functioning System or Component, or restore to an acceptable level the design functions of a failed System or Component.

3.1.8 **Non-Compliance** – When a periodic activity has not commenced prior to its tolerance period being exceeded, without formal approval from the relevant authority.

3.1.9 **Post-Maintenance Testing** – Testing after maintenance to verify that maintenance was performed correctly and that the System or Component can function within acceptance criteria.

3.1.10 **Preventive Maintenance** – Actions that detect, preclude, or mitigate degradation of a functional system or component to sustain or extend its useful life by controlling degradation and failures to an acceptable level.

3.1.11 **PM Basis** – The technical basis for the preventive maintenance regime applied to a specific plant system or component. The PM Basis is the association of the ER equipment classifications with the relevant PM Templates resulting in the PM Strategies.

3.1.12 **PM Strategy** – The PM Strategy identifies and justifies the PM programme on component level. The PM Strategy includes component classifications, the PM tasks to be performed and the respective task intervals, implementation recommendations and requirements related to the PMs and a justification of the PM Tasks.

3.1.13 **PM Task** – A distinct maintenance activity that may require participation by multiple disciplines or groups, performed on one or more components at pre-determined intervals.

3.1.14 **Root Cause** – Fundamental reason(s) for an observed condition of an System or component that if corrected prevents recurrence of the condition.

3.2 Abbreviations

3.2.1 **CSR** – Critically Safety Related

3.2.2 **CMMS** – Computerised Maintenance Management System

3.2.3 **EHR** – Equipment History record

3.2.4 **ER** – Equipment Reliability

3.2.5 **NNR** – National Nuclear Regulator

3.2.6 **OTS** – Operating Technical Specification

3.2.7 **PSA** – Probabilistic Safety Assessment

3.2.8 **QC** – Quality Control

3.2.9 **RCM** – Reliability Centred Maintenance

3.2.10 **SR** – Safety Related

4.0 REFERENCES

4.1 Referenced Documents

4.1.1 10 CFR 50.65: The NRC Maintenance Rule

4.1.2 238-54; Rev 0: Radiation Protection Licencing Requirements for Koeberg Nuclear Power Station

4.1.3 331-65; Rev 0: PSA Reliability Data Collection and Evaluation

4.1.4 335-2; Rev 1 Koeberg Nuclear Power Station Management Manual

4.1.5 36-197; Rev 1: Koeberg Licencing Basis Manual

4.1.6 36-681; Rev 0: Generation Plant Safety Regulations

4.1.7 EPRI TR-1000844: Nuclear Power Plant Common Ageing Terminology

4.1.8 IAEA 50-SG-07: Maintenance of Nuclear Power Plants

4.1.9 INPO AP-913: Equipment Reliability Process Description

4.1.10 KAA-500, Rev 12a: The Process for Controlled Documents

4.1.11 KSA-011, Rev 11: The Requirements for Controlled Documents

4.1.12 LD 1023: Quality management requirements for Koeberg Power Station

4.1.13 LD 1091: Requirements for Licences of Nuclear Installations Regarding Risk Assessment and Compliance with the Safety Criteria of the NNR

4.1.14 NUMARC 93-01: Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

4.1.15 Reg Guide 1.160: Monitoring the Effectiveness of Maintenance at Nuclear Power Plants

4.1.16 SAR, Rev 4: Safety Analysis Report

4.2 Applicable Documents

N/A

5.0 REQUIREMENTS

5.1 General

5.1.1 A process shall exist at Koeberg Power Station to implement, control and monitor the overall continued effectiveness of the maintenance programme.

5.1.2 The maintenance process comprises 12 elements:

(1) Control of the Determination, Documentation and Changes to the PM Basis.

(2) Control of the Planning and Scheduling of Work.

(3) Control of the Development, Authorisation and Assembly of Working Documentation.

(4) Control of Failure Analysis and the Integration of Operational Experience.

(5) Control of the Execution of Work.

(6) Control of Post-Maintenance Requalification.

(7) Control of Equipment History and Plant Asset Configuration.

(8) Control of Programme Compliance.

(9) Control of Maintenance Effectiveness and Performance Monitoring.

(10) Control of Action Plans.

(11) Control of Quality.

(12) Control of Staff Training and Authorisation.

5.1.3 The process elements outlined in 5.1.2 are shown as a flow diagram in Appendix 1. Any changes to this process shall undergo the formal station wide Safety Evaluation Process.

5.1.4 Each element of the maintenance process shall be described in controlled process documentation.

5.1.5 Responsibilities for the establishment, implementation and execution of maintenance management, shall be assigned according to the authorised Eskom organisational structure.

5.1.6 The maintenance organisational structure shall include all administrative, technical and supervisory functions, required to mobilise and supervise both on-site and off-site resources, during plant operation and outages.

5.1.7 Adequate on-site workshops shall be provided for the repair and servicing of equipment.

5.2 Control of the Determination, Documentation, and Changes to the PM Basis

5.2.1 A systematic approach shall be established, documented and used for the scoping and classification of plant systems and components, in terms of their functional importance. Critical equipment shall be identified based on importance to safety function, safe shutdown capability and power generation capability.

5.2.2 A technical basis shall be established and recorded for all PM Strategies on critical plant systems and equipment.

5.2.3 Where a preventive maintenance regime has been previously established, but the basis is unrecorded, the validity of the regime shall be accepted and no technical basis shall be required until such time as a new PM Strategy is developed. Should any change to the intent of the tasks or frequency be required however, a PM Basis shall be established.

5.2.4 The Preventive Maintenance programme shall be established using Equipment Reliability (ER) and RCM principles, in order to prevent or minimise the probability of equipment functional failure, where the consequences of such failure would be unacceptable in terms of:

- Nuclear safety impact
- Personnel safety impact
- Breach of environmental standard/s
- Production/Operational impact
- Economic impact

5.2.5 The preventive maintenance programme shall be focused on maintaining the specified functional capabilities of critical plant systems and equipment.

5.2.6 Where a software database is used to manage any of the PM Basis data, controls shall be established and documented in order to ensure the accuracy and security of the data. User access to the database shall be controlled in accordance with an authorised process.

5.2.7 A summary report listing Preventive Maintenance Programme activities on critical equipment shall be submitted to the NNR on a periodic basis. The report shall identify all PM Strategy updates since the previous submission. As a minimum, this report shall include the following information:

- Equipment Functional Location Code
- Equipment Description
- Task Description
- Task Interval

5.2.8 The Preventive Maintenance Programme shall comply with the requirements of the approved PM Strategies.

5.2.9 Statutory activities resulting from an interpretation of the Nuclear Licence, Occupational Health and Safety Act, Operating Technical Specifications, and the various applicable codes and regulations, documented in the various Koeberg programmes, shall be considered when establishing the Preventive Maintenance Programme.

Where possible, credit shall be taken for these activities in the Preventive Maintenance Programme.

5.2.10 Determination of and changes to the PM Basis shall be controlled in accordance with an authorised process. This process shall ensure that the changes to the bases will not give rise to an adverse impact on nuclear safety in terms of the Koeberg Safety Assessment, e.g. SAR, PSA, OTS and in terms of meeting the Safety Criteria of the NNR.

5.2.11 PM Strategies shall be reviewed as appropriate during the life of the plant, to take into account plant modifications and operating experience.

5.3 Control of the Planning and Scheduling of Work

5.3.1 A process shall exist that enables the planning and scheduling of maintenance activities. This process shall include controls to ensure adherence to the Preventive Maintenance Programme.

5.3.2 The requirements of the Preventive Maintenance Programme shall be entered into the Computerised Maintenance Management System (CMMS) in a controlled manner. Access to the database shall be restricted and controlled.

5.3.3 All changes to the CMMS data shall be effected in a controlled manner. Any changes to the scope or intent of work activities shall only be undertaken after changes to the relevant programme have been authorised.

5.3.4. The process shall address planning and scheduling of work for normal routine tasks, outages, production projects and short duration outages.

5.3.5 Controls shall be established to ensure that the information contained in the CMMS is in compliance with the current authorised PM Strategies.

5.3.6 During the process of planning and scheduling work activities, an assessment of the total plant equipment that is out of service shall be performed, in order to determine the overall effect on the performance of safety functions.

5.3.7 The limitations of Operating Technical Specifications shall not be compromised as a result of maintenance activities.

5.3.8 Maintenance activities shall be graded and the work shall be performed to a level commensurate with the effect that the activity may have on the ability of the component to perform its design function.

5.4 Control of the Development, Authorisation and Assembly of Working Documentation

5.4.1 All working documentation used in the execution of maintenance activities shall be produced and/or changed in accordance with a controlled process.

5.4.2 The level of detail of working documentation shall be commensurate with the equipment importance and the complexity of the activity.

5.4.3 Working documentation shall include appropriate acceptance criteria for demonstrating that important activities have been accomplished satisfactorily.

5.4.4 Working documentation shall be categorised for implementation as follows:

- Procedure in hand
- Procedure at the job site
- Procedure for reference

5.4.5 All working documentation shall be produced in a standard format.

5.4.6 All the documentation required for the execution of an activity shall be assembled into a work package. Appropriate reviews and authorisation shall be performed prior to execution.

5.5 Control of Failure Analysis and the Integration of Operational Experience

5.5.1 Failure analysis shall be conducted following unexpected equipment functional failure/potential failure. The depth of the investigation shall be commensurate with the importance to plant safety and reliability, the complexity of the equipment, the likelihood of recurrence and the impact of the actual failure/potential failure.

5.5.2 Industry operating experience, craft feedback, equipment as found condition trends and equipment failure trends shall be evaluated. These evaluations shall strive to assess the applicability, effectiveness and completeness of the existing PM Strategies and shall recommend improvements to the PM Basis, where necessary.

5.6 Control of the Execution of Work

5.6.1 Prior to the execution of work activities, appropriate work permits shall be in place.

5.6.2 No work shall be undertaken without the appropriate working documentation.

5.6.3 Maintenance activities shall not be used to change equipment from its original specification or to alter the design base of the plant or equipment.

5.6.4 Good housekeeping practices shall be documented and complied with during and after maintenance.

5.6.5 Supervisors shall verify that maintenance has been satisfactorily completed.

5.6.6 The control of materials, equipment, and loose parts during maintenance and manufacture shall exist, in order to ensure traceability of the origin and to prevent loss during assembly or disassembly.

5.6.7 A programme shall be established and implemented to prevent the ingress of foreign material during maintenance and to ensure the removal of all foreign material and loose parts after maintenance.

5.6.8 The use of temporary special devices during maintenance shall be controlled, in order to ensure compatibility with the plant and to control plant configuration.

5.6.9 All maintenance activities carried out by off-site organisations shall be controlled in the same manner as on-site organisations.

5.6.10 Controls shall be established for specific processes used during maintenance or in-house manufacture.

5.6.11 Temporary alterations to the plant shall be controlled in accordance with an approved process.

5.7 Control of Requalification after Maintenance

5.7.1 A process shall exist whereby equipment post-maintenance integrity is verified.

5.7.2 Post-Maintenance Requalification Testing requirements and acceptance criteria shall be determined during the working documentation preparation phase.

5.7.3 All test requirements shall be specified in working documentation.

5.7.4 Tests shall be performed in accordance with written, and authorised documentation.

5.7.5 The scope of Post Maintenance testing will be based on the extent of preventive and/or corrective maintenance performed.

5.7.6 Testing shall be conducted under conditions that represent normal operating parameters. Testing at other than design conditions shall be subjected to a risk review and authorisation process.

5.7.7 Failure to meet the acceptance criteria shall constitute a failure of the test.

5.8 Control of Equipment History Records and Asset Configuration

5.8.1 A process shall exist for the identification, preparation, transmittal, storage and retrieval of Maintenance Equipment History Records (EHRs).

5.8.2 EHRs shall be classified and stored commensurate with their importance.

5.8.3 Electronically stored case history summaries shall be maintained as evidence of activity execution.

5.8.4 All corrective maintenance activities case history summaries shall address as found condition, corrective action and root cause if known.

5.8.5 A process shall be established for the control of Plant Asset configuration.

5.8.6 Where asset numbers exist plant history shall be cross-referenced to both plant location and unique asset.

5.9 Control of Programme Compliance

5.9.1 A process shall exist to ensure that all activities are scheduled to meet their periodicities as defined in the Preventive Maintenance Programme and that they do not exceed the allowable grace period.

5.9.2 The allowable grace period for Preventive Maintenance Programme activities shall be determined and documented in controlling documents. The grace period limit shall be determined based on, and supported by, current nuclear industry best practice.

5.9.3 All activities scheduled for execution shall be monitored to ensure that they are completed as required by the planning schedule.

5.9.4 The grace period may be used without formal sanction in order to facilitate the appropriate planning and scheduling of activities. Use of the grace period for any other reason, shall be subject to a review and authorisation process.

5.9.5 Should an activity not be started before the end of the grace period, a formal management report shall be generated to report the Preventive Maintenance Programme non-compliance.

5.9.6 All Preventive Maintenance Programme non-compliances shall be investigated, rectified and actions taken to prevent re-occurrence.

5.9.7 Any postponement of Preventive Maintenance Programme activities shall be strictly controlled in accordance with an authorised process, which shall assess the impact of and justify any such postponements.

5.10 Control of Maintenance Effectiveness and Performance Monitoring

5.10.1 A programme shall be established to monitor the health of plant systems and components. The systems and components to be monitored shall be identified and controlled in accordance with an authorised process.

5.10.2 System and equipment performance criteria shall be established, performance monitored, adverse trends identified, and corrective actions implemented and verified for effectiveness.

5.10.3 A management committee shall be established to provide oversight on equipment reliability, plant health and performance.

5.10.4 Equipment performance data and associated trend information shall be collected and shall be available to support the prompt identification of problems and root causes.

5.10.5 Plant specific reliability data shall be used to influence the PSA.

5.10.6 A Maintenance Effectiveness Monitoring Programme shall be established to demonstrate the effectiveness of the Preventive Maintenance Programme.

5.10.7 Failure to meet the requirements of the monitoring programme shall be investigated and appropriate corrective actions shall be taken.

5.10.8 Establish a process independent to the Power Station organisation to provide oversight on the health status of the Preventive Maintenance Programme. As a minimum, the following aspects shall constitute the framework of this function or role:

- Review of the PM Programme to ensure its conformance to the licencing requirements.
- Benchmark the PM programme and ER process against best industry practices to remain abreast of the latest industry trends and participate in the peer group process.

5.11 Control of Action Plans

5.11.1 A system shall exist to control all actions resulting from the following:

- Failure analysis
- Industry experience
- As Found Condition Assessment Trends

- Performance monitoring
- Effectiveness monitoring
- Programme non-compliance

5.11.2 The system shall record the status of all actions to ensure the timely close out of open actions.

5.12 Control of Quality

5.12.1 The quality and integrity of the maintenance performed on equipment shall be accomplished by the application of a Quality Control Programme.

5.12.2 The type and duration of QC coverage shall be commensurate with the importance of the equipment to safety and the complexity of the maintenance activity.

5.12.3 Supervision and QC hold and witness points shall be determined and implemented, as appropriate.

5.13 Control of Staff Training and Authorisation

5.13.1 All maintenance personnel performing maintenance activities shall be suitably trained and authorised, commensurate with the importance of the equipment to safety and power generation, and the complexity of the maintenance activity.

5.13.2 All maintenance personnel shall be given training in radiation protection, safety requirements, access control and emergency procedures appropriate to their duties.

5.13.3 The maintenance groups shall maintain registers of personnel who are authorised to perform maintenance activities.

5.13.4 Supervision requirements and authorisation of staff are inter-dependent issues. Where personnel are authorised, supervision requirements may be minimised. Where personnel are not authorised, supervisory input shall be maximised.

5.13.5 For on-job training purposes unauthorised staff may work on CSR or SR equipment. For CSR equipment they shall be under continuous direct supervision of an authorised person. For SR equipment they shall be under the direct supervision of an authorised person.

5.13.6 All maintenance personnel shall be provided appropriate training on the Maintenance Process, on an on-going basis.

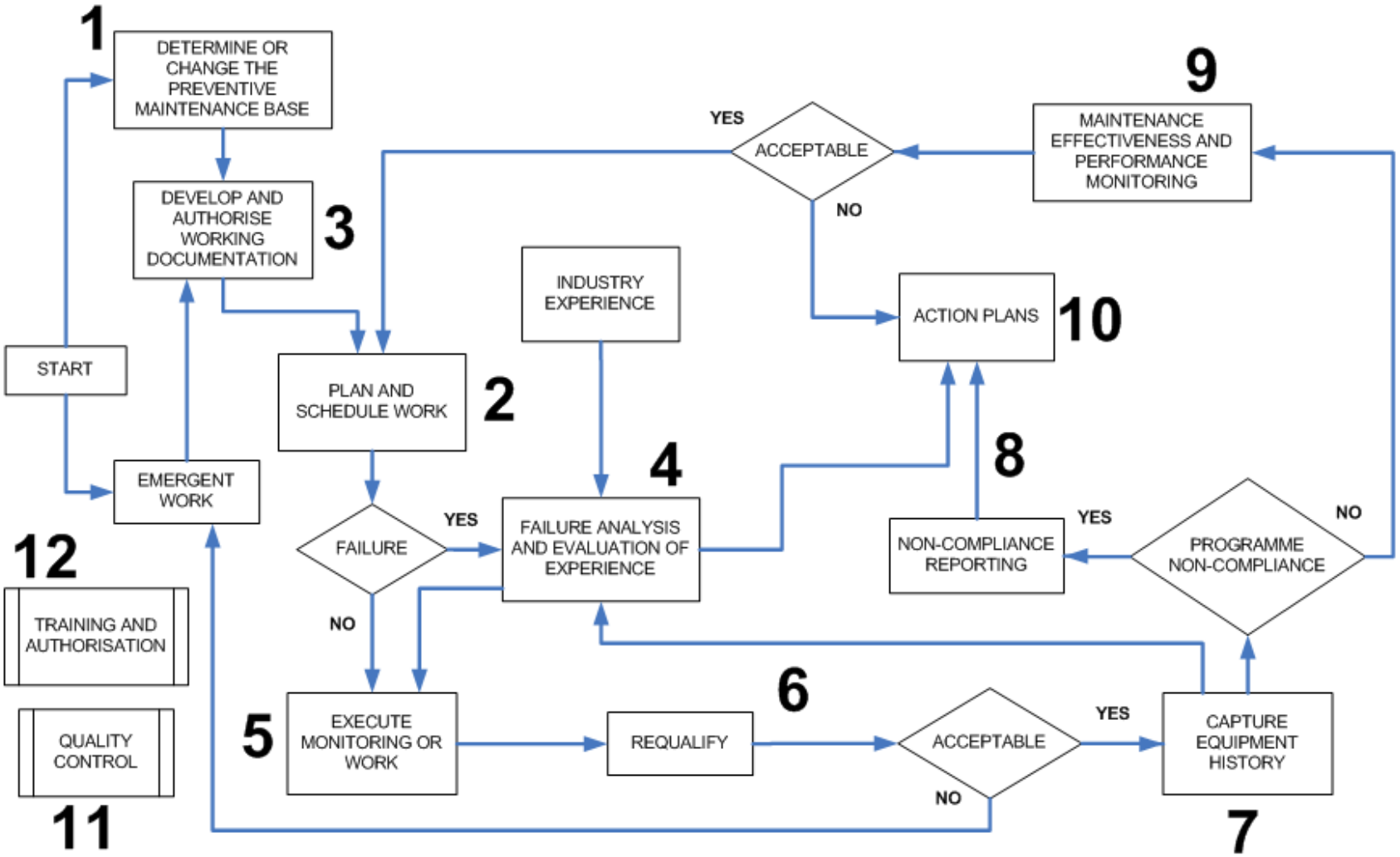
6.0 ATTACHMENTS

Appendix 1 – The Maintenance Process

Appendix 2 – Justification

APPENDIX 1

THE MAINTENANCE PROCESS



APPENDIX 2

JUSTIFICATION

Revision 0

1. Complete rewrite.
2. Reformatted to comply with the requirements of KAA-500 and KSA-011.
3. Reference Number not in accordance with KSA-011 due to familiarly with the “LIC” by the Council.

Revision 1

1. Update of front page.
2. Update CNS to NNR.
3. Update of abbreviations (3.2) and References (4.1).
4. The process will be updated during the initiation of a new procedure KSA-111 which will require NNR input.
5. Full Review.

Revision 2

1. Introduced Equipment Reliability (ER) concept based on the INPO AP-913 process.
2. Introduced the Classification of components based on the ER concept.
3. Updated the preventive maintenance listing requirements to an electronic report.
4. Introduced plant and system health monitoring and the ER oversight role.
5. Updated Intrusive Task Analysis with As Found Condition Code Trend analysis.
6. Allow electronic medium for control and storage of PM Bases.
7. PM Basis & PM Strategy concepts introduced in place of maintenance bases
8. PM programme non-compliance wording used in place of violation.
9. Changes to some of the text in the document for purposes of clarity.