ATTACHMENT 3

SIGNIFICANCE DETERMINATION PROCESS BASIS DOCUMENT

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1. BACKGROUND

Commission paper SECY-99-007A, dated March 22, 1999, described a method for assigning a probabilistic public health and safety risk characterization to inspection findings related to reactor safety. This risk characterization tool was the first of a set of tools that became central elements of the Significance Determination Process (SDP) to determine reactor inspection finding significance consistent with the thresholds used for the risk-informed plant Performance Indicators (PIs). This allowed inspection findings and PIs to both be used consistently as inputs to the plant performance assessment portion of the Reactor Oversight Process (ROP). Subsequently, other SDP tools were developed to characterize the safety significance of issues associated with emergency preparedness, occupational and public radiation safety, physical protection, fire protection, shutdown operations, containment integrity, operator requalification, and steam generator tube integrity. These SDP tools either used quantitative risk evaluation methods or were risk-informed through expert judgement of the staff. The resulting SDP tools were considered acceptable starting points from which to be continuously improved as experience was gained.

The term "SDP" should be considered as an overall process description that includes all associated provisions designed to meet ROP objectives, such as formal opportunities for licensee input (i.e., Regulatory Conferences), NRC management review for any significance characterization of greater than green (i.e., Significance and Enforcement Review Panel - SERP), and licensee appeal options (i.e. defined in IMC 0609, Attachment 2). The SDP is implemented using various cornerstone-specific SDP tools, which may be referred to by their specific names as individual "SDPs." A list of the specific SDPs used in the ROP is provided at the end of this document. A technical basis for each SDP is presented as separate documents within IMC 308.

2. FUNDAMENTAL ATTRIBUTES FOR ALL SDP TOOLS

The following fundamental attributes apply to all SDPs, across all cornerstones. All proposed SDP changes should not detract from maintaining and improving these intended attributes.

A. Objectivity

Each SDP tool should attempt to provide a decision logic or a decision framework that remains constant across applicable findings. This enhances objectivity by minimizing the likelihood that SDP results will be influenced by different value judgements held by different individuals. Where practicable, a probabilistic risk decision framework is used to add this desired discipline to SDP results. The test of having achieved such objectivity is when different individuals using a given SDP decision logic or framework arrive at the same result when using the same input conditions and assumptions. Achieving SDP result consistency and predictability is the intended outcome of the objectivity attribute.

B. Scrutability (openness)

The SDP should be capable of providing a clear framework to facilitate communication of each significance determination and its basis among technically knowledgeable stakeholders (both internal and external). The objective of such communication is to achieve a common understanding, to the extent desired by any interested stakeholder, of SDP decision bases. This allows for broad and independent verification of the staff's objectivity and most directly enhances NRC public credibility. When a quantitative risk model is used, the greatest challenge to achieving this attribute is to allow stakeholders a means to independently assess SDP result sensitivity to the most influential assumptions, to understand the basis of the assumptions, and to reveal the limitations and uncertainties of the risk model and how these were considered by the staff in arriving at a final result. Given the lack of regulatory prescription or approval of the plant-specific assumptions used in licensee probabilistic risk models, it is essential that this scrutability attribute is effective for those stakeholders best positioned to identify logical or factual errors that may alter the final results (e.g., NRC inspectors).

Since 9/11, public access to the risk-informed inspection notebooks used for the SDP Phase 2 process for at power conditions has been restricted. As such, the ability of the public to engage in open communications about plant specific probabilistic risk information has been reduced.

C. Timeliness

The SDP is intended to support timely staff, inspection, and management responses to identified licensee performance deficiencies generally within a timeframe consistent with quarterly updates of the Action Matrix portion of the performance assessment component of the ROP. The SDP timeliness goal is therefore 90 days from the time the inspection finding is documented in an inspection report establishing the need for further review to determine significance. However, SDPs should also allow for a publically observable and understandable licensee/staff dialogue during the staff's decision process, consistent with the scrutability attribute noted above. Balancing SDP timeliness with public scrutability and obtaining best available information requires that all SDPs efficiently focus inspector/staff information exchange with a licensee, starting when a finding is identified. In addition, maintaining public credibility requires timely public notification of the existence of a potentially significant finding and identification of the staff's preliminary basis for potential significance. When appropriate, preliminary SDP results should reveal what influential information is being sought that may change the preliminary estimate. Because the SDP assesses licensee performance deficiencies that occurred in the past and are less likely to occur again, assuming effective corrective actions are taken, its bases need not meet the same standard as staff safety bases used for licensing or similar regulatory actions. This allows SDP decisions to proceed, particularly in the case of risk-informed SDPs, with residual uncertainties that may be greater than those permitted for NRC staff licensing decisions which, for example, may affect the risk profile of a reactor throughout its remaining lifetime. In cases where subsequent licensee analyses or other information may demonstrate to the staff's satisfaction that certain assumptions or judgements used by the staff were previously inaccurate and which change the SDP result, the staff should alter any remaining planned Action Matrix response as appropriate. If this new information arises after all staff response actions have been completed, the staff should incorporate any insights gained for future SDP results or improvements. When new information becomes available that the staff agrees changes the significance of past findings, the licensee should be informed of this decision in writing and the Action Matrix input should be adjusted accordingly from that point forward.

D. Inspection Planning

The SDPs should inform the activities and improve the effectiveness of the inspectors who directly implement the inspection program. Through routine use and application of the SDP tools, inspectors are expected to naturally become sensitized and more alert for findings of significance, with a correspondingly higher likelihood of their identification if they exist. The best means for inspectors, decision-makers, and others to understand plant-specific risk insights, including why a finding either is or is not significant, is to regularly use and understand the SDP tools.

E. Responsibility for Significance Determinations

Each SDP result is the sole responsibility of the NRC staff. The SDP is not a consensus process with a licensee or other parties and no staff/licensee interactions should be construed as a negotiation. The ROP requires the staff to make decisions using best available information in a timely manner and that the bases of SDP results be clear and publically available, to the extent practical and permitted by policy (e.g., security issues). The SDP affords licensees an opportunity to provide available information that may be useful to the staff in arriving at a best informed decision within a reasonable time. The staff is obligated to be clear about the basis for any SDP result and to consider licensee-provided information. The staff is not obligated to have "proof" of the assumptions made relative to an SDP result basis. Staff engineering or technical judgement is often required, but should be consistent with similar previous circumstances as appropriate and is intended to be made objective through its use within the appropriate SDP tool used as a decision framework. A licensee may not appeal the staff's judgements unless the staff did not consider relevant licensee input or did not follow established SDP process.

F. Independence from Other NRC Processes

The significance of inspection findings, as characterized by the SDP, is represented by a color scheme (i.e. green, white, yellow, red) that is consistent with that used for the PIs. The color of an SDP result carries with it an assurance that all of the specific applicable process provisions of the overall SDP have been met. Other forms of significance determination may not have the same process attributes, definitions, or assurances, and therefore should not be characterized using the SDP color scheme. Such other forms may include severity levels of traditional enforcement approaches and other agency probabilistic risk evaluation programs (e.g., Accident Sequence Precursor event or condition evaluations). Keeping the SDP color scheme independent from other forms of significance determination also aids in ensuring clear and consistent public representations that inspection findings with colors are always negative inputs to the ROP assessment of licensee performance.

G. External Stakeholder Participation in SDP Development and Changes

The ROP was developed with substantial involvement from both internal and external stakeholders, notably increasing public confidence and acceptance of the ROP. In addition, the ROP is an integrated set of tools and processes in which changes to one component will likely affect other components. Because of these factors, changes to the SDP must be carefully considered and in some cases it may be beneficial to engage external stakeholders prior to making substantive changes to the SDP or its component tools. Such engagement is not intended to arrive at consensus, but rather to ensure that the staff has considered the possible effects which could occur from a substantive change. It is permissible to make changes which, in the judgement of the staff, do not require external stakeholder engagement.

3. ADDITIONAL FUNDAMENTAL ATTRIBUTES FOR SDP TOOLS USING PROBABILISTIC RISK METHODS

A. Use of Computer-Based Risk Models

Experience with the Senior Reactor Analyst (SRA) position since its inception in 1995 has demonstrated that, for experienced senior inspectors, an 18 to 24 month training and qualification period dedicated to using and understanding risk analysis techniques is needed at a minimum to provide adequate skill and sufficient understanding to begin performing independent risk analyses using computer-based models. Most risk analysts require several years to fully understand the sometimes subtle assumptions built into these models. Providing computer-based tools to non-analysts (e.g., inspectors) generally leads to their use as a “black box,” wherein results are relied upon without necessarily understanding their basis. Improved user interfaces may be developed in the future that might allow direct inspector use of such computer-based tools, but any such development should consider the ROP objectives of scrutability and understanding. Normally, only professionally trained risk analysts should use, review, or present the results of computer-based risk models for regulatory decision purposes, and should seek to facilitate decision-maker and other stakeholder understanding of the most influential assumptions on which the result depends, as well as the range and reasons for modeled uncertainties. This should not be construed as intending to restrict any person’s initiative to seek to understand computer-based risk model results.

B. Importance of a Critical and Open Deliberative Process Leading to Understanding

The reactor safety SDP, like the other SDP tools, is intended to openly reveal the underlying assumptions and logic that form the basis for significance determinations. Probabilistic risk analysis is built, most often through a multi-disciplinary effort, upon many assumptions regarding a plant’s design and operation. However, there is little assurance of the appropriateness or adequacy of the particular modeling assumptions that are most influential to a specific SDP result, without the understanding of those who are best able to judge their adequacy. No probabilistic risk model, no matter how detailed, should automatically be accepted without understanding its influential assumptions, limitations, and uncertainties. In particular, if differences exist between the results of risk evaluations using different plant risk models, the principal cause(s) of the differences must be understood before choosing the most appropriate result that reflects the staff’s best understanding of the issue and the relevant probabilistic modeling assumptions. The risk-informed reactor safety SDP using the risk-informed inspection notebooks, as “Phase 2" of a phased approach, provides an intellectually accessible probabilistic “thinking framework” that in many cases will be consistent at a high functional level with more detailed risk models. Most importantly, this tool should foster risk communication among experienced inspectors, staff, and management in a way that intends to provide a more widespread and common understanding of the basis for a risk result and therefore the ability for technically knowledgeable non-analysts to actively participate in formulating its basis.

In addition to its value as a risk estimation and communication tool, use of the reactor safety SDP Phase 2 process is an effective way for inspectors and other users to gain risk insights. Risk analysts gain risk insights by creating, modifying, and exercising a risk model to understand the influences of the various assumptions it is built upon. Detailed risk models may take months or years for a risk analyst to fully understand. Historically, risk analysts have had great difficulty communicating risk insights to decision-makers and inspectors. This is at least in part because the burden of communication often rested mainly on the risk analyst, and the recipient of this one-way communication was challenged, in the typically short time available, to understand anything other than the face value results. This “one-way” approach relies heavily on the risk analyst to understand the influential assumptions used for a specific situation being analyzed. The reactor safety SDP (using the “Phase 2" plant-specific risk-informed inspection notebooks) offers the opportunity for inspectors to gain risk insights in the same manner that risk analysts gain them: by manipulating a risk model to understand the sensitivity of its underlying influences. By processing issues and findings through the reactor safety SDP, even when it appears they initially may be of very low (“green”) significance, inspectors will gain valuable plant-specific risk insights, just as seeking to understand the technical aspects of an issue through reference to documents such as Technical Specifications and the UFSAR provides valuable understanding of a plant’s design basis. In addition, the reactor safety SDP should be used to identify appropriate risk-informed samples within appropriate inspection procedures by using the prior risk insights gained from applying the SDP or by examining the dominating core damage sequences and the potential influence that any identified deficiencies might have in affecting multiple functions related by specific sequences.

C. Risk-Informed SDP Tools - Specific Principles and Attributes

The principles below upon which the risk-informed SDP tools were developed should continue to be met to ensure the consistency and coherence of all probabilistic SDP approaches. In addition to the Fundamental Attributes for all SDP tools, as noted above, any new SDP tool or change to an existing SDP tool using probabilistic risk approaches should be checked against each of the below additional Specific Attributes.

1. Risk-informed SDP tools are intended to estimate the actual incremental risk increase above the nominal baseline level of probabilistic risk (i.e., delta CDF or delta LERF). It does not attempt to model the likelihood that a degraded condition might have been either better or worse than it actually was. This attribute is intended to help achieve SDP objectivity.

2. No matter how detailed probabilistic risk models become, they will not penetrate to any absolute “true” risk value, due to uncertainties and incompleteness. In fact, the word “model” itself is used to convey the fact that the interactive physical realities of a nuclear plant’s operation and responses (e.g., failure mechanisms, timing of events, human errors of commission) cannot be specified in any absolute sense. Therefore, such complexities must be treated at a higher level that “models” the physical realities. The nature of risk models is to use probability distributions to represent some of the known uncertainties, and the use of numerical probabilities (and probability distributions) is then a means to relatively “weight” various elements of a probabilistic risk model. The results of risk model calculations cannot be fairly equated to those of engineering models (e.g., thermal-hydraulics models) that can be benchmarked against actual physical experiments. Thus, it is crucial that all SDP tools using probabilistic risk methods be represented as “thinking frameworks” that are designed to allow technically knowledgeable persons intellectual access to manipulate the variables within this framework, and explicitly to either accept or challenge the built-in assumptions.

3. Every risk-informed SDP result must be understandable in terms of its influential underlying logic and assumptions. Making probabilistic risk-informed SDP results scrutable and understandable to technically knowledgeable stakeholders helps to 1) ensure that inaccurate assumptions are detected, 2) clearly reveal any limitations of the analyses, and 3) help prevent an analysis from being manipulated to intentionally achieve a particular result. It is necessary to engage in a deliberative process among knowledgeable stakeholders to examine and either challenge or accept important assumptions within a risk analysis. Only through an open deliberative process that results in improved understanding can it be assured that our decision results are based on best available information and are not biased inadvertently or manipulated purposefully.

4. Phase 1, for any risk-informed SDP tool, should aim to expeditiously screen findings for which there is high confidence that the significance is Green. All such findings must still be corrected by the licensee. The staff bears the burden of an appropriate justification for all SDP results determined as greater than Green.

5. Phase 2 for any risk-informed SDP should, as much as possible, provide a simplified risk-informed process that can be implemented by inspectors and be used as a risk communication tool. The public basis for an SDP result does not have to be more extensive or resource intensive than Phase 2 if this basis reflects the staff’s

basic understanding of the significance, which may be checked by professional risk-analysts using more detailed computer-based risk models. Even when the reactor safety SDP tool (phase 2) cannot be used for a particular reactor safety inspection finding because its pre-specified imbedded assumptions are not appropriate to the finding, the departure from the publically documented process (i.e., a phase 3 analysis) can often be understood in terms of appropriate adjustments that are made to the phase 2 model. Thus, the published SDP model may continue to serve a valuable role as a communication tool, even for phase 3 analyses.

6. Phase 3 was defined to address the expected need to depart from the Phase 2 guidance when the Phase 2 modeling assumptions are known to be inaccurate or incomplete, and requires professional risk analysts to be involved in all such cases. (Note that technical analysis to help determine appropriate Phase 2 input assumptions is not a Phase 3 analysis unless such analysis cause probabilistic assumptions to depart from those in Phase 2.)

7. The resource burden of performing an SDP analysis is normally considered appropriate if it reasonably increases stakeholder understanding of the risk basis for any potentially risk-significant condition, especially when a finding is believed to be greater than Green. However, it is appropriate due to SDP timeliness considerations for the staff to cease further effort to refine or review an analysis, acknowledge the limitations and uncertainties, and proceed to a final determination based on best available information and reasonable technical or probabilistic judgements. When making the decision to continue further review, especially when the additional review will cause an issue to be untimely, it is important for the analysts and decision makers to keep in perspective that the purpose of the SDP assessment is to determine what action the staff should take (e.g., supplemental inspection) as a result of the licensee performance deficiency. Experience with the SDP has shown that the resources expended for additional reviews are sometimes not commensurate with the final risk significance of the deficiency and the additional actions taken by the staff.

8. Inspectors should use their evaluation of the significance of a finding with the SDPs as communication tools at the earliest possible opportunity, to discuss the potential significance of the finding with the licensee and with the inspector's management. Inspectors should make available to the licensee their own SDP evaluation as a starting point for further discussion and to gain licensee perspectives. Inspectors should not request a licensee to perform any specific analysis.

9. Inspectors should question, when appropriate, the relevant and influential assumptions related to any SDP result, in part, as a means to focus constructive dialogue (both internal to the NRC and externally with licensees) on gathering the technical information and making the input and assumption determinations that should be given priority in coming to a final significance determination. In particular, differences between risk models must be reasonably understood before a final determination is made.

10. All technical judgements made by the staff within any probabilistic-based SDP tool should have bases that are clearly observable as "reasonable," as well as reasoned, based on best available information, and not purposefully biased in a conservative manner simply because of uncertainties which are applicable in both conservative and non-conservative directions. As a corollary, this also requires that staff technical or probabilistic judgements not be "traded off" within a risk model by allowing a conservative bias in one modeling factor simply because another factor is believed to be non-conservatively biased. In some cases it may be appropriate to demonstrate that a particular factor does not influence an SDP result by artificially

setting it to the most conservative (i.e., greatest risk outcome) value. In such cases, the purpose for doing this should be clearly documented.

4. RISK-INFORMED VERSUS RISK-BASED

The reactor safety SDP process is considered risk-informed, not risk-based, and supportive of the Commission Policy on Use of Probabilistic Risk Assessment Methods in Nuclear Regulatory Activities (1995). As defined in SRM SECY-98-144 revision 1, dated March 1, 1999, a "risk-based" approach to regulatory decision-making is one in which such decision-making is solely based on the numerical results of a risk assessment. Under this definition, the approach taken by the ROP (for both PIs and the SDP, where appropriate) might be considered "risk-based." However, the SDP is considered risk-informed by virtue of the expectation that SDP result bases are sufficiently understood by those technically knowledgeable persons (such as inspectors and technical staff) who are best positioned to critically examine the most influential probabilistic and technical assumptions, as well as by the management decision-makers who ultimately make the decisions. Conversely, if decisions are made without an understanding appropriate to the objectives of the ROP, they are risk-based.

As further defined in this SRM, a "risk-informed" approach should consider "other (unspecified) factors." Historically such "other factors" included those listed in Regulatory Guide 1.174 such as maintaining defense-in-depth, compliance with regulations, engineered safety margins, and prevention of over-reliance on human operators for rapid critical decisions. However, these factors are all already represented, in various ways, in a probabilistic risk model. Other "factors," such as NRC management assessment of the general quality of licensee programs, have historically inserted significant subjectivity into reactor oversight decision-making. Given the ROP objective to improve objectivity, the risk-informed approach used within the ROP fundamentally views the use of a probabilistic framework as a decision-framework which lends greater intellectual discipline and objectivity to the ROP decision process and less reliance on subjectivity.

5. PERFORMANCE DEFICIENCY BASIS

All inspection findings must originate with the staff's determination that a licensee performance deficiency exists. A performance deficiency may exist independently of whether any regulatory requirement was violated. Conversely, a regulatory requirement may be violated without any corresponding performance deficiency. The need to characterize the performance deficiency arises from the probabilistic treatment of significance determination as discussed further below, but the concept is carried throughout all the cornerstone SDPs.

Probabilistically, a reactor plant creates an incremental risk to the public that is maintained very low through compliance with NRC regulations, license requirements, and good operating practices. A plant's "baseline" risk (using the surrogates of CDF and LERF for public risk) is founded upon a risk model of that plant using failure probabilities and initiating event frequencies generally derived from industry-wide historical experience, sometimes modified where appropriate from plant-specific experience (e.g., Loss of Offsite Power frequency might be higher than the average for a plant subject to hurricanes). The risk-informed SDP uses each plant's "baseline" risk as the reference point for estimating the incremental increase in risk caused specifically by a degraded condition that could increase an initiating event frequency or reduce the probability of successful mitigation, and that stemmed from a licensee performance deficiency that is subsequently remedied (i.e., the degradation was temporary and not expected to recur). The ROP guidance requires that the staff clearly articulate the performance deficiency that caused the degradation that resulted in the risk increase. Applied across all cornerstones of safety, this serves the following purposes:

1) The basis for every finding is explicitly grounded in deficient licensee performance, and thus all inspection inputs to the ROP licensee performance assessment process reflect licensee performance problems (there is no 'credit' offset for good performance).

2) If the staff cannot identify a licensee performance deficiency when a degraded condition occurs, then this is considered part of the "baseline risk" imposed by a large complex industrial facility, in which failures occasionally occur even though all regulatory expectations and standards are met. Such cases should prompt consideration of the adequacy of the applicable regulatory requirements and standards, and be addressed by regulatory processes other than the ROP. Also, when such degraded conditions involve violations of regulatory requirements, these must be documented in accordance with enforcement policy guidelines, but not treating them as "findings" parallels allowing "enforcement discretion" under traditional enforcement policies.

3) It provides a more objective and understandable basis for the staff to determine that the licensee performance deficiency, as defined, has been or is being addressed by the licensee prior to "closing" greater than green findings from the Action Matrix.

Based on the above logic, the definition of a performance deficiency requires the staff to make a reasonable determination that the licensee intended to meet some requirement or standard and they did not, having had the opportunity to forsee, identify, or correct the performance deficiency that led to not meeting the requirement or standard. Such a requirement or standard need not be directly imposed by the NRC. Licensee good operating practices are expected as a means to ensure safety and minimize risk, and may be implemented as initiatives that go beyond regulatory requirements (e.g., management of shutdown safety by following industry-developed guidelines). When such self-imposed standards or requirements are not met due to deficient performance, this may cause an estimable risk impact and should be the basis for a finding. Note that this differs from the pre-ROP inspection program in that findings need not only be associated with violations of regulatory requirements, which is in keeping with a risk-informed program emphasis.

Finally, it is important to recognize that discernable risk increases come from degraded plant conditions, both material and procedure/process in nature, and that the performance deficiency should most often be identified as the proximate cause of this degradation. In other words, the performance deficiency is not the degraded condition itself, it is the proximate cause of the degraded condition. This determination of cause does not need to be based on a rigorous root-cause evaluation (which might require a licensee months to complete), but rather on a reasonable assessment and judgement of the staff. For those findings proposed to be of greater than green significance, the Significance and Enforcement Review Panel (SERP) functions to provide oversight to ensure the staff's reasonableness and consistency of identifying licensee performance deficiencies and their nexus to the degraded conditions that cause the increase in public risk.

6. TREATMENT OF CONCURRENT DEGRADED CONDITIONS

The use of the ROP Action Matrix demands that its inputs be discrete and not duplicative. When separate licensee performance deficiencies result in separate degraded conditions that overlap each other in time, there could be a synergistic risk impact during the overlapping period of time that is greater than the sum of the two parts. This possibility motivated the development of a rule to treat such conditions. This rule considered the following points.

The staff is responsible to define licensee performance deficiencies. Where the proximate cause of multiple degraded conditions is the same, there is likely to be only one finding (based on the identified performance deficiency related to the proximate cause) and the risk impact of the collective degraded conditions (including any overlapping conditions) is then appropriately used as the basis for the SDP result. However, this concept could be taken to an extreme of defining all licensee performance deficiencies as "management weakness" or something similarly fundamental. Doing so would then cause all degraded conditions to be manifestations of a single and possibly never-ending finding, would make unnecessary the need for an Action Matrix, and may require the staff to devise a continuous risk meter or similar substitute for the Action Matrix. Thus, a "floor" was set for the implementation of this concept that is consistent with the ROP framework, in that no performance deficiency should be defined at a level associated with the ROP cross-cutting issues (i.e., human performance, safety-conscious work environment, and problem identification and resolution) or more fundamentally. Although artificially setting this "floor" may create a philosophical inconsistency with use of a probabilistic thinking framework (i.e., if there is really a known common-cause effect taking place, then it should be explicitly acknowledged in a probabilistic model), it remains necessary for practical reasons as long as the Action Matrix continues in its present form. Concerns about possible insufficient regulatory responses arising from this approach are also mitigated as noted below.

When multiple findings are judged to be separate and independent of each other, yet cause degraded conditions that overlap in time, the SDP will treat them independently and thereby allow the Action Matrix to receive multiple inputs and perform the "summing" of these risk impacts (along with all other cornerstone inspection and PI inputs) to inform the degree of regulatory response required for that licensee. This approach has the valuable benefit of allowing individual SDP risk determinations to proceed independently and therefore generally in a more timely fashion. In most cases, it is believed that the "summing" result of the Action Matrix will produce a regulatory response equal to that of combining the multiple findings into a single finding of collective risk significance. The staff's use of risk tools in other processes (e.g., Accident Sequence Precursor Program) or simply for the purpose of understanding collective risk significance may be appropriate, and in those cases where it is determined that such understanding should alter the agency's response to the specific licensee, the staff may invoke a deviation from the Action Matrix by appropriate justification and meeting the prescribed process requirements of the ROP.

7. TREATMENT OF UNCERTAINTY

One of the strengths of probabilistic risk assessments is that certain uncertainties can be treated explicitly. The openness of SDP deliberation helps to reveal influential assumptions and uncertainties. The risk-informed SDP process inherently and qualitatively considers uncertainty. The "point-estimate" numerical risk values are understood to represent averages/means which are central tendency parameters of probability distribution functions and as such do not represent any dispersion characteristic (i.e. spread) of these functions. In addition, it is recognized that limitations exist for any specific risk model, in terms of completeness of the model and basis for its various probabilistic (e.g., accident sequence logic) and technical (e.g., success criteria for mitigation functions) assumptions. Consideration of uncertainty was built into the overall risk-informed SDP process three distinct ways. First, the decision thresholds (i.e., significance color categories) were chosen to be one order-of-magnitude intervals. Thus, a numerical "point-estimate" determination that falls anywhere within a particular order of magnitude is given the same color characterization in recognition of the uncertainty stemming from the known variability of certain input data and assumptions. Second, the staff's determination of the most appropriate and reasonable assumptions, where they significantly influence the SDP result, rests on an understanding of both the strength of the basis for each assumption and the assumption's relative influence on the SDP result. The openness of the SDP process is designed to allow persons with relevant technical knowledge to understand the basis for risk significance and, as appropriate, participate in formulating the most appropriate assumptions. Third, the openness of the SDP process also encourages understanding of any known incompleteness of the risk model being used. The degree to which any such incompleteness might affect the SDP result then becomes a clearly revealed consideration within the deliberation process. Overall, an open and deliberative process that invites relevant input ensures that the bases upon which assumptions are made, and the residual uncertainties inherent in such bases, are clearly understood and considered in arriving at a final SDP result.

8. USE OF DELTA CDF (AND DELTA LERF) AS THE SDP RISK METRIC

The relationship between delta CDF and CCDP (conditional core damage probability) is described below. This discussion is also correspondingly applicable to the relationship between delta LERF and CLERP (conditional large early release probability).

A. Different Definitions of CCDP -

In the below discussion, the use of "CCDP" is primarily with reference only to degraded conditions. The term CCDP is also commonly used to represent the probability that a core would have gone to a damaged state given that (i.e., "conditioned on") a specific initiating event occurred and the actual plant equipment and operator responses are accounted for. This "event" use of CCDP represents the remaining probabilistic "margin" (related to defense-in-depth) to core damage at a precise moment in time, that of the event itself. This concept of CCDP is significantly different from that which refers to a degraded condition which may alter the plant's risk over a period of time and is related to the plant's ability to mitigate a number of different possible initiating events.

B. Overview

The risk-informed SDP tools are designed to estimate the increase in annualized CDF risk due to identified deficiencies in licensee performance that led to unavailability of equipment or safety functions, or to the increase in initiating event frequencies. This increase is measured from the normal annualized CDF that results from routine plant operation. The additional risk contributions caused by deficient licensee performance (as characterized by the SDP) are assumed to be additive to this normal annualized CDF which already includes the risk contribution due to the probabilities of equipment failures expected occasionally for industrial facilities of this size and complexity.

Another contribution to normal annualized CDF is caused by planned preventive maintenance and testing activities which cause the CDF at any particular moment in time to fluctuate dependent upon the changes in plant equipment status. The additional annualized CDF risk due to deficient licensee performance must be dependent only upon the performance issue itself and not the particular plant configurations during which the issue occurred. Therefore, if a degraded equipment or function is identified to exist simultaneously with equipment outages for preventive maintenance or testing, the SDP inputs cannot include the contribution of the maintenance or testing, since this is already included in the normal annualized CDF against which the change is being measured. This non-consideration of routine maintenance and testing is a departure from the historical enforcement practice of including the consideration of any additional equipment unavailability that made the loss of function due to a deficiency more severe, even if the added unavailability were due to routine maintenance.

The SDP actually estimates the CCDP given the degraded condition which resulted from the performance deficiency, for the time this degradation existed. The nominal CDP, which accounts for normal maintenance, during this time, is subtracted from the CCDP to obtain the change in CDP due to the degraded condition alone (without consideration of any specific maintenance configuration that might have existed). This numerical result is then normalized by dividing it by 1 year to arrive at a delta CDF in units of "per year." If equipment outages due to maintenance were included in this delta CDF estimation, the result would potentially render results of higher significance. This would result in assessments of the risk impact of licensee performance that inappropriately would depend as much on the licensee's appropriate conduct of on-line maintenance as on the licensee's deficient performance.

The objective of using the SDP is to characterize the significance of inspection findings in a manner that is comparable to performance indicators for use in the NRC Action Matrix. The reactor safety cornerstone performance indicator thresholds were developed based on the increase to annualized CDF represented by the value of the indicators. Thus, in comparing and "adding" the effects of PIs and inspection findings within the Action Matrix, it is necessary to use the same risk metric.

C. Basis in Regulatory Guide 1.174 and Mathematical treatment of delta CDF and CCDP -

In developing the new performance assessment process one of the tasks was to establish risk-informed thresholds for PIs and corresponding thresholds for inspection findings, so that indications of performance degradation obtained from inspection findings and from changes in PI values could be put on equal footing. The basis documents for establishing risk guidelines were Reg Guide 1.174, which bring in the Regulatory Analysis Guidelines, and the Safety Goal Policy Statement. The metrics that have been adopted in RG 1.174 for the characterization of risk are CDF and LERF. These are essentially surrogates for health effects, which are the principal metrics in the Safety Goal Policy Statement, and, in addition, they are consistent with the metrics used in the Regulatory Analysis Guidelines. In RG 1.174, acceptance guidelines were established for assessing changes to the licensing basis of a plant. Acceptance is predicated on increases in CDF and LERF implied by the change to the licensing basis being small.

The philosophy behind the establishment of the thresholds on PIs and inspection findings was essentially to assume that an increase in PI values or conditions indicated by the finding, would, if their root causes were uncorrected, be equivalent to accepting a de facto increase in the CDF and LERF metrics. This is clearer for the PIs than it is for the inspection findings, which may relate to a time-limited deficient condition. For such cases, the model used here is that the condition is indicative of an underlying performance issue that, if uncorrected, would be expected to result in similar occurrences with the same frequency.

Therefore, the challenge is how to calculate the impact of changes in PI values and inspection findings on these metrics. Since PIs correspond (at least in some approximate sense) to parameters of PRA models, it is relatively straightforward to make the connection between changes in PI values to changes in risk. The thresholds were established by taking a set of PRA models, and varying the parameter that corresponded to the PI until the change in CDF became 1E-05 or 1E-04/ry, and these values were chosen as the thresholds for the white/yellow and yellow/red thresholds. Therefore, the risk significance of an inspection finding should be measured in the same way. When the impact of the finding can be characterized in terms of the unavailability of an SSC for some specified duration, then the SDP gives an estimate of the change in CDF.

However, a finding that is associated with one SSC may be compounded by another SSC being out for routine maintenance or being in a (unrevealed) failed state. Enforcement practices have typically escalated enforcement for such coincidences, even though, performing maintenance can be a necessary and beneficial operating practice. Also, failures will, and should be expected to, occur, and if they are unrevealed even though the licensee is following acceptable practices, it may penalize the licensee for an occurrence beyond their reasonable and expected control. The NRC Accident Sequence Precursor process typically includes any additional failures or unavailability in its assessment of risk significance. Therefore the question has arisen whether when applying the SDP, the failed or unavailable SSC that is not related to the finding per se should be treated as a failed or unavailable SSC.

In assessing the risk significance of the finding on the same basis as the PIs, it has to be remembered that the metric is CDF (LERF), and that CDF is an estimate based on a weighted average of all possible outcomes. Thus the key issue is how the finding is defined. If the finding relates to a specific reason that a particular SSC is, or has the potential to be, unavailable (for example a failure to follow a particular procedure) then it should, for the purposes of the SDP, be irrelevant whether another SSC is unavailable because it has been taken out of service for routine or scheduled maintenance, unless the cause of the reason for the maintenance is also related to deficient licensee performance. If the condition of independence holds, the finding has only by chance occurred when the second SSC was unavailable, and the occurrences are uncorrelated. The chance that the events could have occurred simultaneously is accounted for in the SDP by using unavailability values for the redundant or diverse trains or systems that reflect the probability that they are unavailable.

However, the finding could be related to the component taken out of service. For example, if the reason the second component were taken out of service at the same time as the first component were unavailable is that a required check on operability of the first was not performed, the finding relates to the failure of the administrative process. The finding would relate to the second component, i.e. that which was taken out of service, and the failure of process being addressed could have and, given the assumption that, if uncorrected, it more than likely could have occurred when the first component was available. Therefore, in assessing the significance of the failure to follow the administrative process in the SDP, the first component should not be regarded as having failed. Instead, the SDP would be entered with the second component out of service as the condition of degradation, and the first component treated as being an alternate train. This is a somewhat contrived example which raises other questions in that if it were a generic degradation of the adherence to administrative procedures rather than for a specific procedure this would be impossible to analyze with the SDP.

Including the plant configuration as part of the finding is equivalent to risk tracking, as captured by a safety monitor for example, and is a record of one sample of all the possible outcomes, or a snapshot of the condition of the plant. It is however, not directly related to the estimate of the risk impact in the sense required for calculating)CDF. It is more accurately characterized as a measure of the margin to core damage, which could be measured as a CCDP (for plant trip events), or a conditional core damage frequency (CCDF). There are currently no acceptance guidelines for CCDF or CCDP. Note that the ICCDP in RG 1.177 could be interpreted as an estimate of **)**CDF, in the same way as discussed above. However, we do not have a criterion for either CCDP or CCDF.

Suppose we were to derive appropriate criteria, we would still have to answer the question of how to interpret the data to generate a useful measure of the margin to core damage. If some of the failures that contribute to a high CCDP or CCDF are truly random, then does it make sense to penalize the licensee because they occur? It could be argued that since failures can and do occur, and as long as the indicators associated with those SSCs are acceptable, then the licensee could have done little to avoid this situation. What makes much more sense is to track the residual CCDP or CCDF with respect to the deliberate changes to plant configuration, i.e., those unavailabilities over which the licensee has direct control.

A mathematical demonstration that, for a simple unavailability, **)**CDP equates to **)**CDF over one year follows below.

We want to show that, for a given basic event representing unavailability of an SSC, that the following holds:

$CDF = [T_0/(T_0 + T_1)].CDF_0 + [T_1/(T_0 + T_1)].CDF_1$,

where T_0 is the time when the SSC is available, and T_1 the time when it is not, CDF_0 is the CDF evaluated with the SSC available (i.e., unavailability = 0), and CDF_1 is the CDF calculated with the SSC unavailable, (i.e., unavailability = 1). $T_0 + T_1 = 1$ year.

That is, the addition of a CDP coming from a particular unavailability finding equates to an increase in CDF.

Note that the cutsets for CDF can be split into two groups, those that do not contain the SSC , which therefore corresponds to CDF_0 , and those that contain the SSC. These cutsets would typically be of the form x.y.z.U, where U is the unavailability of the SSC in question.

CDF_1 then is CDF_0 + **E**(x.y.z.U) with the value of U set to 1.

Thus the equation above becomes

$CDF = CDF_0 + [T_1/(T_0 + T_1)]$.**E**(x.y.z.U) with the value of U set to 1.

Now, if we replace the value of U by $[T_1/(T_0 + T_1)]$, we get the usual CDF expression.

Thus, while what we are doing in the SDP is evaluating a CDP, i.e., an integral under a CDF spike, and translating it to an increase in CDF for the year in which the finding occurred.

END

Appendices to Attachment 3 (presented as separate documents in the Manual Chapter)

Appendix A	Significance Determination of Reactor Inspection Findings for At-Power Situations
Appendix B	Emergency Preparedness Significance Determination Process
Appendix C	Occupational Radiation Safety Significance Determination Process
Appendix D	Public Radiation Safety Significance Determination Process
Appendix E	This document has been designated as containing “Official Use Only” information and is therefore not available to the public.
Appendix F	Fire Protection Significance Determination Process
Appendix G	Shutdown Operations Significance Determination Process
Appendix H	Containment Integrity Significance Determination Process
Appendix I	Operator Requalification Human Performance Significance Determination Process
Appendix J	Steam Generator Tube Integrity Findings Significance Determination Process
Appendix K	Maintenance Risk Assessment and Risk Management Significance Determination Process