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ACTIVITY/PROJECT SPECIFIC PROCEDURE

SP 9-8
MONITORING PARAMETER ASSESSMENT PER 40 CFR 194.42
Revision 4

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1.0 Purpose and Scope

This procedure prescribes the Sandia National Laboratories (SNL) Waste Isolation Pilot Plant (WIPP) process used to meet the 40 CFR 194.42 regulatory requirement to monitor WIPP performance against WIPP Performance Assessment (PA) expectations. This procedure is used to:

1. Derive and revise Trigger Values (TVs),
2. Annually assess WIPP monitoring data against PA expectations and document these activities in a Compliance Monitoring Annual Report,
3. Periodically assess the impacts of changes to WIPP programs on the Compliance Monitoring Parameters (COMPs) program and provide Department of Energy (DOE) with recommendations for changes to the program, a requirement for WIPP recertification, and
4. Revise COMP assessment process when related PA elements are changed.

This procedure defines the role of the Scientific Advisor (SA) in the Compliance Monitoring Program and, in particular, the general strategy for how the SA will derive COMPs and employ TVs to facilitate the rapid screening of monitoring data (Section 2.3). A TV is a measure or limiting value for a particular set of COMP-related monitoring data, that when exceeded, indicates the data may represent a significant change in the Compliance Baseline and merit further evaluation/analysis. It should be noted that exceedance of TVs does not in itself represent an out of compliance condition. The process the SA uses in planning modifications to the WIPP monitoring program and assessing impacts of potential changes to the monitoring program is also defined (Section 2.5). The interaction between the SA, DOE, Environmental Protection Agency (EPA) and the integration of the TV, COMPs and reporting programs is outlined in Appendix B.

Acronyms and definitions for terms used in this procedure may be found in the Glossary located at the Sandia National Laboratories (SNL) WIPP Online Documents web site.

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2.0 Implementation Actions

2.1 Regulatory Requirements

The long-term radioactive waste disposal regulations at 40 CFR Part 191 (EPA 1993) and the implementing WIPP-specific criteria at 40 CFR Part 194 (EPA 1996) require administrative and engineering elements to be employed in addition to the protective natural features of geologic disposal. These elements are called “assurance requirements” and are intended to provide additional assurance and confidence in the long-term compliance of the WIPP with the containment requirements of the EPA. Types of assurances include, but are not limited to active institutional controls, monitoring activities, passive institutional controls, and engineered barriers within the disposal system. This document focuses on the monitoring aspect of the assurance requirements.

In the WIPP Compliance Certification Application (CCA; DOE 1996), the DOE made commitments to conduct a number of monitoring activities to comply with the criteria at 40 CFR 194.42 and to ensure that important deviations from the expected long-term performance of the repository are identified at the earliest possible time. These DOE commitments are represented by ten Compliance Monitoring Parameters (COMPs) (DOE 1996, Section 7.2, Table 7-7). COMPs are listed in Section 2.3.

The COMPs are an integral part of the overall WIPP monitoring strategy. The larger overall monitoring program includes several individual monitoring activities, each of which may have one or more drivers, such as state regulations, formal agreements, federal regulations, and health and safety considerations. The DOE’s Compliance Monitoring Implementation Plan for 40 CFR 191.14(b), Assurance Requirement (CMIP; DOE 2023) describes how information and data from the various WIPP monitoring programs are also used to support the Compliance Monitoring Program and associated COMPs.

2.2 Responsibilities and Organizations

For COMP assessment, collection and reporting data derived from the WIPP monitoring programs are the responsibility of the Management and Operating Contractor (M&O). The Scientific Advisor (SA - SNL) uses these monitoring data and observations to derive values for the ten COMPs and to evaluate them against performance expectations of the disposal system. The performance expectations are based on results from the WIPP PA, and its associated features, events and processes (FEP) screening arguments, scenarios, models, and parameter values that form part of the DOE’s Compliance Baseline. The results of the SA’s evaluation are reported to the DOE annually while approximately five years of data and assessment for the periods between recertifications are included in each recertification application.

2.3 Trigger Value Derivation and Revision

Each of the COMPs shall be reviewed to determine if a TV is appropriate. A TV shall be derived for those COMPs identified in this review. The justification for those COMPs without TVs shall also be documented. The original COMPs were derived for the first WIPP certification application (CCA) through a 40 CFR 194.42 analysis documented in CCA Appendix MON, Attachment MONPAR (DOE 1996). A summary of the derivation and final selection of COMPs is detailed in CCA Chapter 7 (DOE 1996, Table 7-7). Interactions between the TV program, COMPs, reporting and interactions between these programs and the EPA are shown in the flow chart of Appendix B. The COMPs selection process took into account the availability of data from existing monitoring programs, the ability of the parameter to be monitored, and the potential for a parameter to verify PA predictions or identify deviations from expected long-term repository performance. The current COMPs include:

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1. Drilling Rate
2. Probability of Encountering a Brine Reservoir
3. Waste Activity
4. Subsidence
5. Changes in Groundwater Flow
6. Change in Groundwater Composition
7. Creep Closure
8. Extent of Deformation
9. Initiation of Brittle Deformation
10. Displacement of Deformation Features

The process for justifying and deriving TVs is shown in Figure A.1 of Appendix A. This section describes the general process and documentation requirements. The COMP titled "creep closure", is used as an example for deriving a TV[1]. Appendix A of this procedure also contains an example of a TV record. Because the derivation of TV is based on project experience and often does not involve quantitative analysis, a TV can only indicate a *potentially* significant condition or event. This distinction provides necessary flexibility in setting the TV to identify noteworthy changes and to ascertain the significance of the observation. If a TV cannot be used to identify such a condition or a justification can be developed that shows the COMP is not indicative of a potentially significant condition or event, a TV is unnecessary.

Step 1: Identify COMPs. This step identifies appropriate and meaningful COMPs. The rationale and selection of the current ten COMPs is contained in the CCA Appendix MON and Chapter 7 (DOE 1996). Because COMPs may represent vastly different processes or conditions, some may be evaluated directly against a benchmark, while others are more qualitative. For example, the COMP "drilling rate", is reported as a single value and can be evaluated directly. Alternatively, the COMP "initiation of brittle deformation", is reported as a set of observations and/or measurements which can then be related to PA indirectly by validating or invalidating a conceptual model assumption or parameter within the model. In each case, the monitoring data used to derive the COMP must be identified and the characteristics of the data defined, as reported in the M&O annual report(s).

Any data manipulation or interpretations required to generate the COMP will be specified in the TV report, a product of this procedure, and these processes shall be appropriately documented and validated.

Step 1 lists background information related to the COMP, identifies what is reported by the M&O for the COMP, and identifies how monitoring data are used to derive the COMP. A table shall be generated with the following information for each COMP.

- COMP Name
- M&O Program that generates related data
- Related PA Parameters
- FEPs with related Screening Decisions/Text
- Related Modeling Assumption(s)
- Other Information as appropriate

Step 2: Map COMPs with PA Elements. This step maps the COMPs to the PA elements, such as FEP screening arguments, model assumptions, and/or parameter values that they directly affect or influence. Mapping between the COMPs and the PA has already been done at a general level in the CMIP (DOE

[1] The example is used for informational purposes only, the actual "creep closure" COMP trigger value must be derived and documented per this procedure.

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2023, Table 2.1) and in Appendix MON of the CCA. As with Step 1, any data manipulation required to generate the PA elements from the COMPs will be specified and the manipulation process appropriately documented. For example, the COMP "drilling rate" is combined with the area of the WIPP repository and the area occupied by waste to derive a rate constant for use in the WIPP PA.

Step 3: Determine COMPs Baseline. This step uses the PA interrelationships identified in Steps 1 and 2 to attempt to determine an existing baseline for COMP-related monitoring data on the basis of the information that was used to derive the Compliance Baseline. The Compliance Baseline for the WIPP PA elements is established from the information supplied in the CCA, CRAs and additional information supplied by the DOE to the EPA Docket.

A review of records such as WIPP Parameter Data Entry, Parameter Problem Report and historical Forms (NP 9-2-1, NP 9-2-2 and the former 464 Form) will help in establishing the baseline. Memoranda such as those found in Appendix MASS of the CCA and subsequent CRA's, that document how site characterization data were used to derive/support PA screening, modeling assumptions, and parameterization will help as well. CRA-2019 Appendix SCR (DOE 2019) and the Input Parameter Report for the 2019 Compliance Recertification Application Performance Assessment (Kim and Feng 2019) can also be used to research COMP baseline information[2]. For example, the "drilling rate" baseline information is found in Kim and Feng (2019, Table 38, Parameter GLOBAL:LAMBDAD), which documents the number of boreholes per km^2 per year based on boreholes drilled over the last 100 years in the Delaware Basin. Using the baseline for the DBMP monitoring of drilling activity each year, it will be readily apparent whether the drilling rate is increasing or decreasing with respect to the baseline.

Step 4: Relate COMP to Repository Performance. This step will compile a qualitative and/or semi-quantitative indication of the impact that changes in the PA elements identified in Step 2 have on the performance of the disposal system. This assessment uses results from sensitivity analyses performed for the CCA (Appendix MON, Appendix SA, Performance Assessment Baseline Calculations, Helton et al. 1998) and other appropriate sensitivity analyses performed as part of proposed change requests and recertification activities.

The ultimate performance measures, and the measures whereby significance is measured at 40 CFR 194.4(b)(3)(ii), are calculated releases, doses and groundwater concentrations. However, the majority of PA elements will have little or no direct bearing on these measures. Therefore, intermediate measures, such as brine inflow and gas pressure, may also be used to indicate influences on sub-system performance. Such measures can be used to evaluate significance according to the EPA's definition at 40 CFR 194.42(c) which states that "A disposal system parameter shall be considered significant if it affects the system's ability to contain waste or the ability to verify predictions about the future performance of the disposal system." This definition was used by the DOE in Appendix MON of the CCA to determine the list of ten COMPs.

Step 5: Determine what represents a "significant" change. This step uses the baseline values identified in Step 3 and the impact of changes in the PA elements from Step 4 to determine what degree of changes in the monitoring data (i.e. TVs) could be significant. The COMPs assessments may yield results that indicate a reportable condition under EPA regulations. The DOE's subsequent course of action is determined by the nature of the evaluation:

1. The COMP data indicate an unplanned and significant change from expected performance. In this case, the DOE will notify the EPA within 24 hours or 10 days, depending on whether the change indicates a possible exceedance of the containment requirements.

[2] The most recent versions of these CRA-related documents will be referred to as they become available (i.e., CRA-2026).

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2. The COMP data do not indicate a significant change from performance expectations. In this case, the monitoring results and evaluations will be reported to the EPA as part of the DOE's annual reporting commitment and periodic recertification process. These COMP data may also be used to support a proposed modification of the Compliance Baseline.

Changes in data that map to PA elements with only sub-system influences in Step 4 are unlikely to be significant according to the EPA's discussion in 40 CFR 194.4(b)(3)(ii) and as ranked in CCA Section 7.2. For this reason, there may be instances where the COMP is determined not to be significant to performance, is qualitative, or where a TV is not practical. In such cases, no TV is necessary; however the justification for this conclusion must be documented in the TV report. An example of the information to be included in the TV report is provided in Appendix A.

Step 6: Determine adequacy of Steps 1 through 5. The work outlined in steps 1 through 5 must be independently reviewed to ensure the work adequately determined appropriate TVs or revisions to TVs. The TV report documents the derivation and revisions to TV. This report must include sufficient information to justify COMP TVs and be consistent with the current compliance baseline and regulatory requirements.

2.3.1 Trigger Value Derivation Report

The product of the TV derivation is a TV Derivation Report (the first report was produced during the first WIPP certification (Beauheim et al. 2002)). The TV report documents the derivation and justification for TVs for each COMP. The report contains the results of the steps outlined in Section 2.3 and must be reviewed and revised when the COMPs program is revised or when the results of the annual COMPs report recommends a review of a COMPs TV. The following outlines the steps to derive new TV for new COMPs or may be used for revisions to existing TVs. Revisions to the TV report are to be made on an as needed basis.

2.3.2 Trigger Value Revisions

The procedure for revision of TVs will be largely based on revision to the information and evaluation in Steps 4 and 5 above. However, changes to the data manipulation processes in Steps 1 and 2 may require the associated TVs to be entirely re-derived. Modifications to the TVs and monitoring programs can be recommended to the DOE by the SA at any time. Changes to the monitoring program and the COMPs may require EPA approval prior to implementation per the requirements of 40 CFR 194.4, however TVs do not apply since they were not part of the original certification basis. TVs are only a tool to aid DOE in identifying conditions that could lead to a reportable change from expected conditions. Revisions to TVs are documented by a revision to the TV Derivation report.

2.4 Annual COMPs Reporting

The DOE CMIP (DOE 2023) outlines the DOE's compliance monitoring program. This procedure identifies and prescribes SNL's compliance monitoring responsibilities contained in the DOE CMIP. Figure B.1 of Appendix B of this procedure describes these activities designed to assess, use, and document compliance monitoring parameters and describes the interactions between DOE and EPA.

The SNL lead responsible for generating the annual COMPs report must obtain the necessary data for the ten COMPs. The M&O Monitoring Program Administrator is responsible for transferring data to the SA and is the communication point for the M&O. The annual data period is from July 1st to June 30th. This period is used because it matches that of the annual EPA 194.4(b)(4) Report.

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The Annual COMPs Assessment Report shall use the information from the last annual COMPs report and revise the information using the latest data (see Wagner and Hillesheim 2008, the 2007 COMPs report as an example for the format and content of the report). The assessment must reference or contain the COMPs data and document the results of the COMP derivation and comparison with the TVs. The assessment must include a conclusion that either states that the results are within the expected ranges or values or they are not. If the results are outside those expected, the assessment must assess the significance of the results and recommend actions to mitigate the impacts of the results. These actions may include:

- reporting to the DOE the potential significance of the monitoring results
- recommend additional analysis to determine the significance, causes or indicate modifications to the PA methodology to account for the impacts of the monitoring data
- recommend revision of the TV
- recommend further monitoring to determine the trend of the data or COMP value
- recommend changes to the compliance monitoring program

2.4.1 Annual COMPs Report

The COMPs results shall be documented in a report. The report shall include a formal record reviewed per NP 6-1, Document Review Process. The annual report generated by the SA is intended to be submitted to EPA either annually as part of the 40 CFR 194.4(b)(4) reporting requirements (Submitted by the M&O annually) or as reference material in the periodic compliance recertification applications. The annual COMPs reports are submitted to the DOE Office of Regulatory Compliance.

2.5 Assessing the Impacts of WIPP Programmatic Changes on the Compliance Monitoring Program for Inclusion in Recertification Applications

The objective of this part of the procedure is to determine the adequacy of the current monitoring parameter (MONPAR) analysis for use in the periodic compliance recertification applications[3]. If the assessment determines that the conclusions of MONPAR are not adequate, the activities necessary to redefine meaningful monitoring parameters pursuant to 40 CFR 194.42 shall be performed under a separate analysis plan.

The approach of this procedure is to determine which changes should be considered in the reassessment and then qualitatively determine the impact of these changes on the conclusions drawn in the MONPAR analysis. These changes include the following activities that have occurred since the last certification activities were completed:

- Monitoring Results
- Experimental Activities
- PA Changes – Methodology/Parameter/Implementation
- WIPP Operational Changes
- Proposed changes to activities and conditions approved by the EPA

A final report or memo shall be generated to document the results of this assessment. The report or memo shall list the changes assessed and systematically determine the impact (if any) these changes have on the conclusions of the current MONPAR analysis and its basis. The assessment shall focus on any impact on the original conclusions (parameters to be monitored) of the MONPAR analysis and shall be used to determine if the MONPAR analysis requires modification or reanalysis. The assessment will result in one of the following conclusions:

[3] Attachment MONPAR (attached to Appendix MON of the CCA) provides the analysis that identified the 10 original compliance monitoring parameters that represent the current COMPs.

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- The current MONPAR basis is not impacted by changes and is adequate for the recertification application – original analysis conclusions are unchanged;

- The current MONPAR basis is not significantly impacted by the changes – (document the affected areas of the analysis and significance justification) - original analysis conclusions are unchanged;

- The current MONPAR basis is significantly impacted such that the original conclusions are likely to be different upon completion of a new monitoring assessment.

The results of the reassessment shall be documented in a report or memo.

2.5.1 MONPAR Reassessment Report

The product of this activity is a MONPAR Reassessment Report or memo. This report documents the derivation and justification for the Compliance Monitoring Program's continued compliance with 40 CFR 194.42. The report shall contain the results of the steps outlined in Section 2.3. The report shall include a formal record reviewed per NP 6-1, Document Review Process. Sources of error and uncertainty relating to this reassessment shall be noted in the reassessment report. Requirements for identification and control of sources of analysis error and uncertainty for a reanalysis shall be included in an analysis plan governing a new MONPAR assessment (if warranted). This activity is associated with the generation of a Compliance Recertification Application.

2.6 Safety

The tasks and activities associated with this procedure are expected to be performed within a normal office environment, thus no unusual health or safety concerns are anticipated.

2.7 References

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Vignes, C., J. Bean, and B. Reedlunn. 2023. *Improved Modeling of Waste Isolation Pilot Plant Disposal Room Porosity*. SAND2023-04826, Sandia National Laboratories, Albuquerque, NM.

Wagner, S. and M. Hillesheim. 2008. *Sandia National Laboratories Compliance Monitoring Parameter Assessment for 2007*, Sandia National Laboratories, Carlsbad NM. ERMS 548041.

3.0 Records

The following records, generated through implementation of this procedure, shall be prepared and submitted to the WIPP Records Center in accordance with NP 17-1 (Records):

QA Record

- Trigger Value Derivation Report
- Annual Compliance Monitoring Parameter Assessment Report
- Assessment of Programmatic Changes on the Compliance Monitoring Program for Inclusion in Compliance Recertification Applications (MONPAR Reassessment)

4.0 Appendices

Appendix A: Trigger Value Derivation Flow Chart Using Creep Closure COMP as an Example and COMPs TV Documentation Example

Appendix B: COMPs Flow Chart

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Appendix A

Step 1
Define the procedure for deriving COMPs.
Define the COMP-related monitoring data characteristics (i.e., what is actually measured/observed and reported).

Example
The COMP "creep closure" is determined from an extensive array of instruments (e.g., convergence points and extensometers), as reported through the WIPP Geotechnical Monitoring Program.

Step 2
Map COMP-related data to:
- PA parameters
- FEP screening arguments
- Conceptual models
- Model assumptions

Define data manipulation procedures used to process COMP data for PA purposes. Generate COMP Table

Example
The amount of creep closure is a function of time, gas pressure, and waste matrix strength. Monitored data provides validation of the creep closure conceptual model.

Step 3
Use relationships identified in Steps 1 and 2 to identify COMP-related data that were used to support PA. Define the Compliance Baseline for these COMP and monitoring data in the context of the PA element(s) derived from them.

Example
The baseline for creep closure is based on a multi-mechanism deformation creep model developed by Munson and Dawson (1979). Porosity surface calculations have been updated using Sierra/SolidMechanics (Vignes et al. 2023).

Step 4
Use previous project experience (sensitivity analyses, CCA monitoring analysis, etc.) to compile an indication of the impact that changes in the PA elements identified in Step 2 have on the performance of the disposal system.

Example
The WIPP underground is essentially stable relative to most operational mines, and deformation is steady for long periods of time. However, under certain conditions, creep rates accelerate which indicates a structural change to the deformation processes.

Step 5
Derive Trigger Values for COMP-related monitoring data. Trigger Values will represent deviations from the Compliance Baseline determined in Step 3. Trigger Values exceedance may identify significant impacts on the performance of the disposal system, as determined in Step 4 or simply indicate variances with related conceptual model.

Example
The closure rate increase signals potential decoupling of rock. The TV requires creep closure rates to change by less than one order of magnitude in a one-year period.

Step 6
Perform independent review of results per NP 6-1.

Figure A.1: Trigger Value Derivation Flow Chart.

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COMP TV Documentation Example

For each COMP:

Title

Related Monitoring Data

- Monitoring Program
- Data-type ID.
- Data characteristics (e.g., number, observation, units)
- Compliance Baseline value (if any)

COMP Derivation Procedure

Related PA Elements

- Title
- Element type (e.g., FEP, parameter, modeling assumption)
- Relationship/derivation procedure (to COMP and/or related monitoring data)
- Compliance Baseline value
- Significance of change in value (based on experience)

Assigned Monitoring Data Trigger Values

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Appendix B

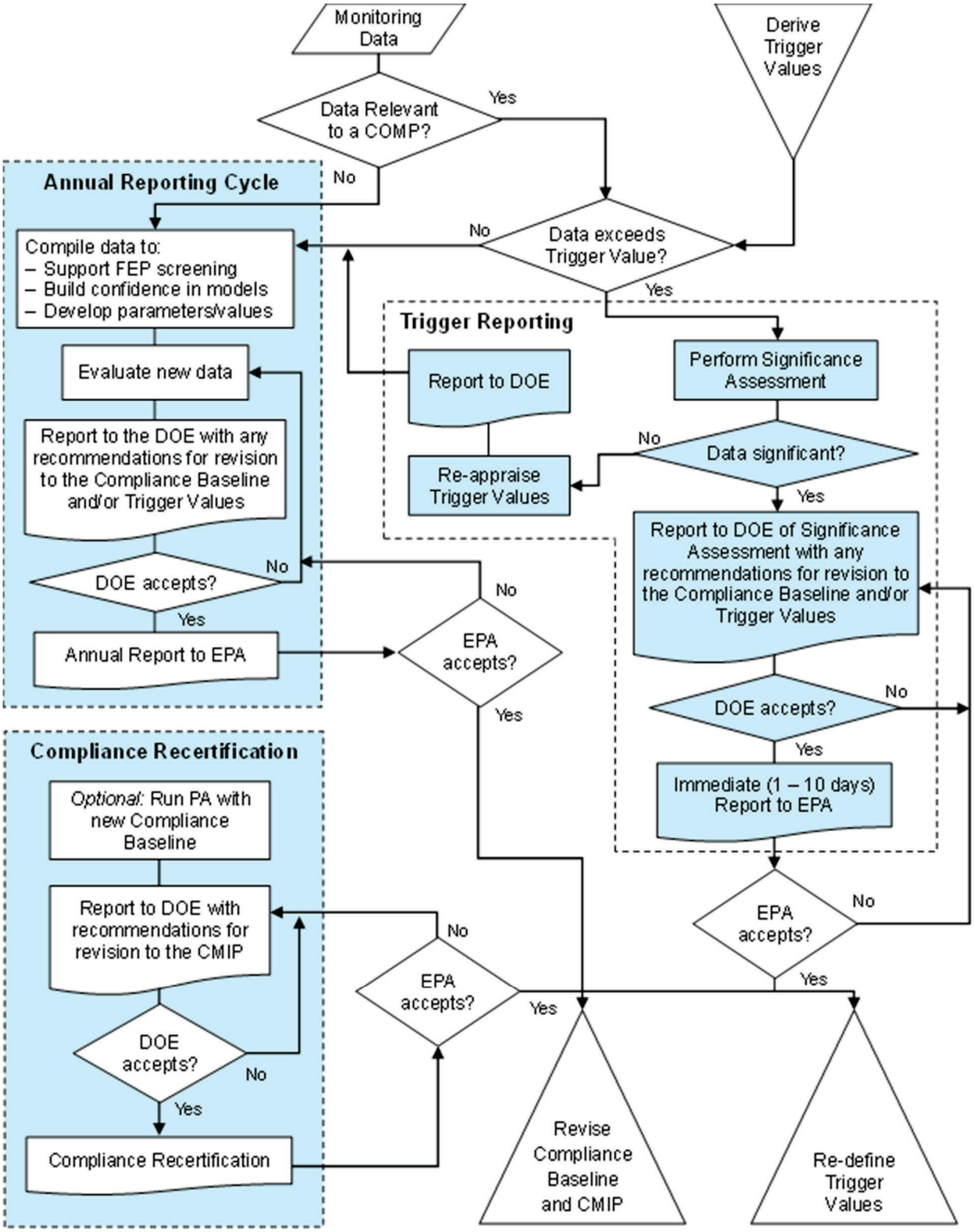


Figure B.1: COMPs Flow Chart.

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