# PBGC PIMS Peer Review

## Evaluation Report of the ME PIMS Recoded Model

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**November 2020**

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CHEIRON

November 6, 2020

Mr. Ted Goldman, FSA, EA, MAAA, FCA
Pension Benefit Guaranty Corporation
Director of Policy, Research, and Analysis
1200 K Street, NW, Suite 11201
Washington, DC 20005-4026

Dear Mr. Goldman:

We are pleased to submit the Evaluation Report of the ME PIMS Recoded Model. The purpose of this report is to provide a targeted analysis, including the methodologies and integrity, of the PBGC's ME PIMS Recoded Model. Our independent review satisfies the annual peer review requirement under Section 40233(a) of MAP-21.

In the Background section we review the objectives of the project, give an overview of the Legacy and Recoded model, and discuss the data provided for the project as well as limitations in our review. The Summary of Key Findings section is a condensed version of the results of our review with further information found in the Approach and Analysis section. Finally, we summarize our findings in the Conclusion section based on the four objectives:

- Confirm the methodologies used to develop cash flows, liabilities, and other pertinent calculations are performed consistent with multiemployer program provisions.
- Identify changes in methods and assumptions from the Legacy model by comparing outcomes and evaluate whether those changes are likely to improve the results of the modeling.
- Review actuarial calculations in the Recoded Model to assure accuracy.
- Summarize findings and provide recommendations to address those findings based on the results of the review.
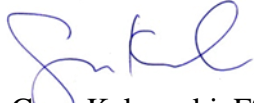
As you'll see, we conclude the Legacy and Recoded Models are not generally the same because of differences in the underlying data, assumptions, and methods. However, based on our review and knowledge of the model, the Recoded Model produces results that are an appropriate reflection of the Multiemployer Pension universe and PBGC's Net Position.

This report and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this report. This report does not address any contractual or legal issues. We are not attorneys, and our firm does not provide any legal services or advice.
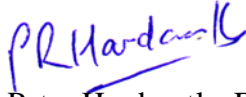
This report was prepared exclusively for PBGC's Board of Directors for the purposes described herein and satisfies the annual peer review requirement under Section 40233(a) of MAP-21. Other users of this report are not intended users as defined in the Actuarial Standards of Practice, and Cheiron assumes no duty or liability to such other users.

Sincerely,
Cheiron

Gene Kalwarski, FSA, EA           Peter Hardcastle, FSA, EA         Christian Benjaminson, FSA, EA
Principal Consulting Actuary     Principal Consulting Actuary      Principal Consulting Actuary

cc:      Christopher Mietlicki, ASA, EA
         Alex Godofsky, ASA

## SECTION I - BACKGROUND

Cheiron has been hired to provide the Pension Benefit Guaranty Corporation (PBGC) with a review of its MultiEmployer Pension Insurance Modeling System (ME-PIMS) valuation models. The primary objective of the review is to provide a targeted analysis including the methodologies and integrity of the PBGC's ME PIMS Recoded Model.

ME-PIMS was entirely recoded during 2018 to make it more efficient and powerful. The result – the ME PIMS Recoded Model – provides an increased level of flexibility and allows the PBGC to better respond to congressional and other stakeholder questions as the insolvency of the program approaches.

This report reviews the methodologies and integrity of the newly developed Recoded Model. The stated objectives of the review are as follows:

- Confirm the methodologies used to develop cash flows, liabilities, and other pertinent calculations are performed consistent with multiemployer program provisions;
- Identify changes in methods and assumptions from the Legacy model by comparing outcomes and evaluate whether those changes are likely to improve the results of the modeling;
- Review actuarial calculations in the Recoded Model to assure accuracy; and
- Summarize findings and provide recommendations to address those findings based on the results of the review.

The objective of the review is to assure accuracy of the calculations in the model rather than identify improvements to the structure. This evaluation report focuses solely on identifying any differences in assumptions, methodologies, or calculations between the Recoded Model and the Legacy Model. For each potential issue identified in the review, the report explains the nature of the concerns, assesses the significance on overall results, and recommends alternatives.

## SECTION I - BACKGROUND

### The Models

In this report we refer to the earlier model as the "Legacy Model" and later models as "Recoded" models. Key features, assumptions, and descriptions of the models are summarized in the table below.

| | Legacy Model | Recoded Model |
|---|---|---|
| Programming Language | C++ (500,000 lines of code, difficult to model Technical Assistance changes) | Microsoft Excel with Visual Basic programming (reduces run time and brings added flexibility to more easily model Technical Assistance changes) |
| Projection Period | Up to 20 years, 500 stochastic trials | 50 years, 500 stochastic trials |
| Economic Assumptions | Projected interest rates, various bond yields, inflation and equity returns (see PIMS System Description) | Same |
| Data Source | Form 5500 (mainly Schedule MB, H and I) | Same |
| Plan Universe | 300 Plans | All Plans |
| Development of Benefit Payment Streams | Projects census data from age/service scatter forward each year with mortality experience | Calibrated in separate model, adjusted to match current liability and expected benefit payments for the starting year |
| Mass Withdrawal Probabilities | Based on ME-PIMS regression formula | None assumed |

The PBGC completed an independent review of the two models, reconciled results, and resolved differences. The Recoded Model was reviewed by PRAD staff, outside contractors (Lynchval and Bolton), and CBO. PRAD presented the findings of the Recoded model to the Board of Directors on July 19, 2019 (see PowerPoint "Support for ME-PIMS FY2018 Transition to Updated Model").

## SECTION I - BACKGROUND

**Data Provided**

In preparing this report, we relied on information (some oral and some written) supplied by the PBGC. This information includes, but is not limited to the following:

- the ME PIMS Recoded Model after enhancements (ME2019 2016MB PR MPRA fixed claim 20190601 new MPRA assump – PR F.xlsb)
- sample plan results from the ME PIMS Legacy Model and Recoded Model before enhancements for eight plans (five plans that are expected to require financial assistance and three healthy plans),
- system documentation for the Legacy and Recoded Models (see files listed below), and
- documents reconciling the results of both models (see files listed below).

**Files Provided**

- FY18 ME Crosswalk_Stochastic_No_MPRA PR.xlsm
- PlanAvgsBaseline_(20190506)_PIMS_1to1280 with SP v2 NoMPRA PR.xlsx
- scenario template 2019 v2 - 2018 No MPRA PIMS Assump.xlsb
- PlanAvgsBaseline_(.....).csv
- ScenariosBaseline_(.....).csv
- ME2019 2016MB PR MPRA fixed claim 20190601 new MPRA assump – PR F.xlsb
- MultiEmployer Spreadsheet Model Description.docx
- Data Dictionary 20190708.xlsx
- fy-2018-projections-report.pdf
- MultiEmployer Spreadsheet Model FY 2019 Release.docx
- FY 2019 ME Crosswalk PR.xlsx
- ME Model Enhancement Tracking.xlsx
- ME PIMS Transition 20190719.pptx

**Limitations**

In responding to the PBGC's request to bid on this project the assumption was that Cheiron would have access to the program code used for the Legacy Model, the Recoded Model, and an enhanced Recoded Model. However, due to concerns about the readability of the Legacy code and concerns about the sensitivity of changes made to the original Recoded Model, to assist PBGC in answering technical questions from Congress, only the code for the enhanced version of the Recoded Model was made available.

The Recoded Model includes input benefit payment streams by plan, which were generated outside of the model. The development of these streams is a critical component of the overall model but was outside the scope of this project. We comment in our report, that given the significance, PBGC may consider an independent review of the model used to create the benefit payment vectors.

## SECTION I - BACKGROUND

Cheiron appreciates PBGC's assistance throughout this project. They were extremely helpful in providing explanations and supporting information to answer our questions. There are certain sections in this report where we relied upon PBGC's descriptions of the assumptions and methods used in the Legacy Model.

**Disclosures**

This report and its contents have been prepared in accordance with generally recognized and accepted actuarial principles and practices and our understanding of the Code of Professional Conduct and applicable Actuarial Standards of Practice set out by the Actuarial Standards Board as well as applicable laws and regulations. Furthermore, as credentialed actuaries, we meet the Qualification Standards of the American Academy of Actuaries to render the opinion contained in this estimate. This report does not address any contractual or legal issues. We are not attorneys, and our firm does not provide any legal services or advice.

This report was prepared exclusively for PBGC's Board of Directions for the purpose described herein and satisfies the annual peer review requirement under Section 40233(a) of MAP-21. Other users of this report are not intended users as defined in the Actuarial Standards of Practice, and Cheiron assumes no duty or liability to such other users.

## SECTION II - SUMMARY OF KEY FINDINGS

Based on our review, we have determined that, while the Legacy and Recoded models are different, the Recoded Model includes enhancements and refinements and produces results that are an appropriate reflection of the Multiemployer Pension universe and PBGC's Net Position. The differences between the models are explained by either the underlying data, assumption changes, or methodology changes which were generally known and intentionally different. For example, in our opinion, the contribution assumption changes made as part of the enhanced Recoded Model are a better reflection of what is likely to happen upon plan insolvency. Ultimately, we conclude, the enhancements and assumption changes between the Legacy and Recoded models are appropriate and improve the results of the model.

Below we summarize our key findings; additional support and analysis is found in the "Approach and Analysis" section of this report.

The key findings are as follows:

- The Recoded Model and Legacy Model produced similar Net Positions (the Recoded Model producing a Net Position that is $1.82 billion lower on 10/1/2028 and $1.27 billion lower on 10/1/2018). The table below shows the breakdown of the Net Position between the two models. As you can see, there are differences in the key components, but these are generally explained by the underlying data differences, changes in assumptions, or changes in methods which are described throughout our report. Overall, the results of the model accurately reflect PBGC's Net Financial Position.

| $ Billions | Legacy Model | Recoded Model Before Enhancements | $ Change | % Change |
|---|---|---|---|---|
| **10/1/2028 Values** | | | | |
| 1. Assets of PBGC Multiemployer Program | ($4.426) | ($6.987) | ($2.56) | 57.9% |
| 2. PV of projected Partition Payments | $0.160 | $0.217 | $0.06 | 35.6% |
| 3. PV of projected Assistance Payments | $66.582 | $62.145 | ($4.44) | -6.7% |
| 4. Net Position on 10/1/2028 [1. – 2. – 3] | ($71.168) | ($69.349) | $1.82 | -2.6% |
| **Net Position discounted to 10/1/2018** | ($52.329) | ($51.059) | $1.27 | -2.4% |

### SECTION II - SUMMARY OF KEY FINDINGS

- The Present Value of Financial Assistance ("PV FA"; for Scenario 1 out of 500) is significantly different in three of the five sample plans we reviewed: 100% for Plan #4, 69% for Plan #13, and 20% for Plan #14. While some of the sample plans use different starting data, the main differences are due to the assumption and methods changes to contributions and/or benefit payments which are discussed later in the report. The differences are generally logical and rational.

| Sample Plan # | $ Billions | PV FA Legacy | PV FA Recoded | % Change |
|---|---|---|---|---|
| #1 -- Critical & Declining, 390,000 Participants, Actuary projected insolvency in 2025 | | $16,191 | $16,869 | 4% |
| #3 -- Critical & Declining, 100,000 Participants, Actuary projected insolvency in 2022 | | $3,749 | $3,993 | 7% |
| #4 -- Critical & Declining, 73,000 Participants, Actuary projected insolvency in 2028 | | $1,882 | $3,762 | 100% |
| #13 -- Critical & Declining, 35,000 Participants, Actuary projected insolvency in 2021 | | $807 | $1,360 | 69% |
| #14 -- Critical & Declining, 50,000 Participants, Actuary projected insolvency in 2020 | | $1,296 | $1,561 | 20% |

- Both models have the same starting value of PBGC's assets, and the discount rates and asset return parameters appear to be consistent.

- The models use the same economic scenarios including a fixed investment return assumption for the largest Critical and Declining plan (based on that plan's revised asset allocation and its plans for an orderly passage to insolvency this is a reasonable change).

- The Legacy and Recoded models use starting data from different years (a known difference). The Recoded Model was simplified to use the same plan year data for all plans (the 2016 Form 5500 data) to avoid adjusting timing differences for different plan years. From the sample plans we reviewed Plan #1, Plan #3, and Plan #4 used the 2017 Form 5500 information in the Legacy Model. This data difference was known by PBGC.

- The models have different methodologies for determining benefit payments (a known difference and enhancement to the Recoded Model to permit projecting the full universe of plans). The Legacy model used the age/service scatters included as attachments to the Form 5500 to project the census data profile forward annually; the Recoded Model used sample benefit payment curves, fitted to the information on the Form 5500 using a separate model. From the sample plans reviewed, the impact appears to have reduced the Net Position.

  The graph below illustrates the methodology difference for Plan #14. Note the dotted line (only available from the Recoded Model) represents benefits before reduction to the PBGC Guarantee). As shown the annual benefit payments are lower in the Recoded model, which by itself should reduce the Present Value of Financial Assistance. However, the Present

## SECTION II - SUMMARY OF KEY FINDINGS

Value of Financial Assistance for Plan #14 is 20% higher which is attributable to the lower contributions (see next bullet) and earlier insolvency.
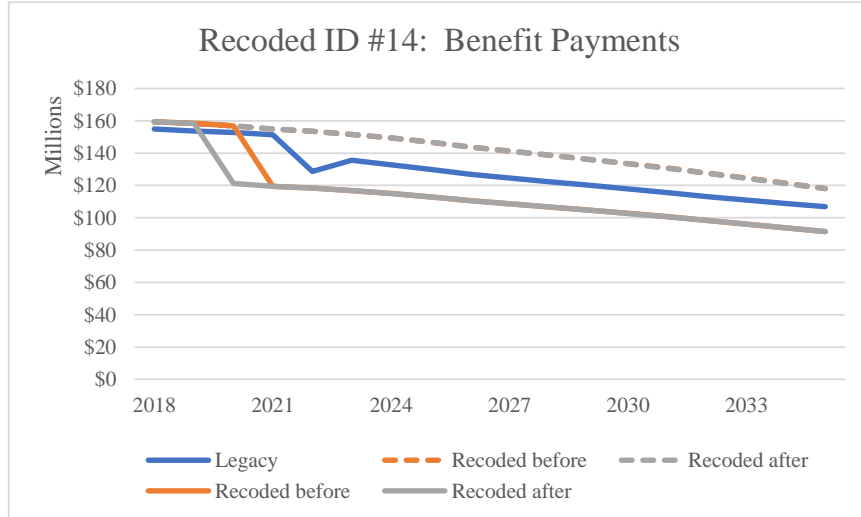


- The Recoded Model (with enhancements) included changes to assumptions for plan contributions, mass withdrawal, and rate of decay and a different algorithm for timing of mass withdrawal. These assumption changes were reasonable and improved the accuracy of the projections. As shown in PBGC's July 19, 2019 PowerPoint, the contribution assumption changes increased the Net Deficit by $16.2 billion.

Again, we illustrate the methodology difference for Plan #14. The contributions are similarly reduced upon insolvency, but the Legacy model remains fixed thereafter while the Recoded model declines over time. This accounts for the earlier insolvency date and the higher Present Value of Financial Assistance. In our opinion, the contribution assumption changes in the Recoded model are a better reflection of what is likely to happen upon plan insolvency.
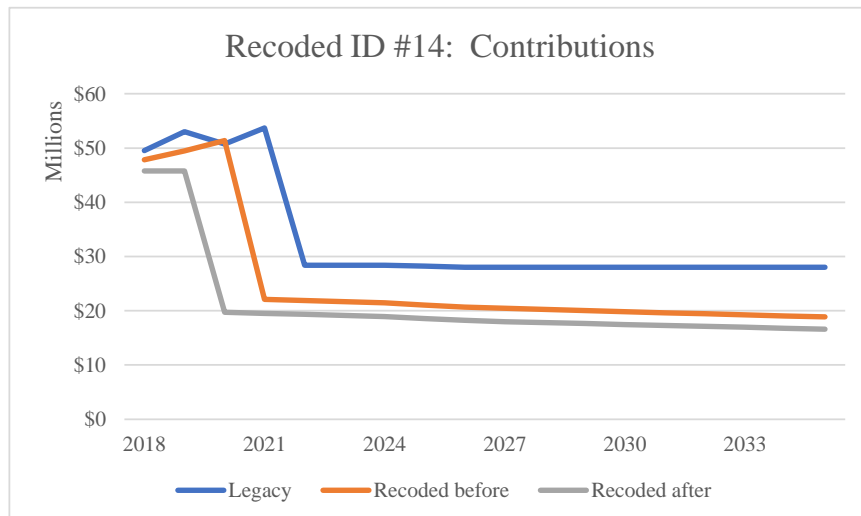
## SECTION III -APPROACH AND ANALYSIS

This section describes how we reviewed PBGC's Legacy Model and Recoded Model and presents the differences we discovered. Please review the "Limitations" in the Background Section of this report for the constraints we encountered.

The Net Position of PBGC's Multiemployer Guaranty program relies on two processes: 1) projecting PBGC assets and liabilities, and 2) testing for insolvency for all insured plans. The first process includes a projection of PBGC assets with premium income, investment returns, and financial assistance payments from previously insolvent plans and plans that are expected to become insolvent in the future. The second process includes a projection of cash flows for each insured plan to test for insolvency and subsequent PBGC financial assistance.

In the Legacy Model, both processes were completed in one program. Following the recoding exercise, the process is performed using two separate models. The first model provides input for the benefit payments taking vectors of future payment streams for currently retired participants, currently terminated vested participants, the accrued benefits of current actives, and the next year's accrual for current actives. This is obtained from a model that manipulates known projected cash flow vectors from actual multiemployer plans so that the manipulated cash flows have present values equal to the current liability values reported on the Schedule MB. Cheiron was instructed to accept the cash flows input to the model used for the first step outlined here. The second model (of which we were provided the version "ME 2019 2016 MB PR MPRA fixed claim 20190601 new MPRA assump – PR F.xlsb") completes the first process and produces output files used to develop results and graphs for PBGC's Projection Report ("scenario template 2019 v2 – 2018 No MPRA PIMS Assump PR").

## SECTION III -APPROACH AND ANALYSIS

# Simplified Flow Chart of ME PIMS Recoded Process
*(Processes in tan color were not examined as part of this review.)*
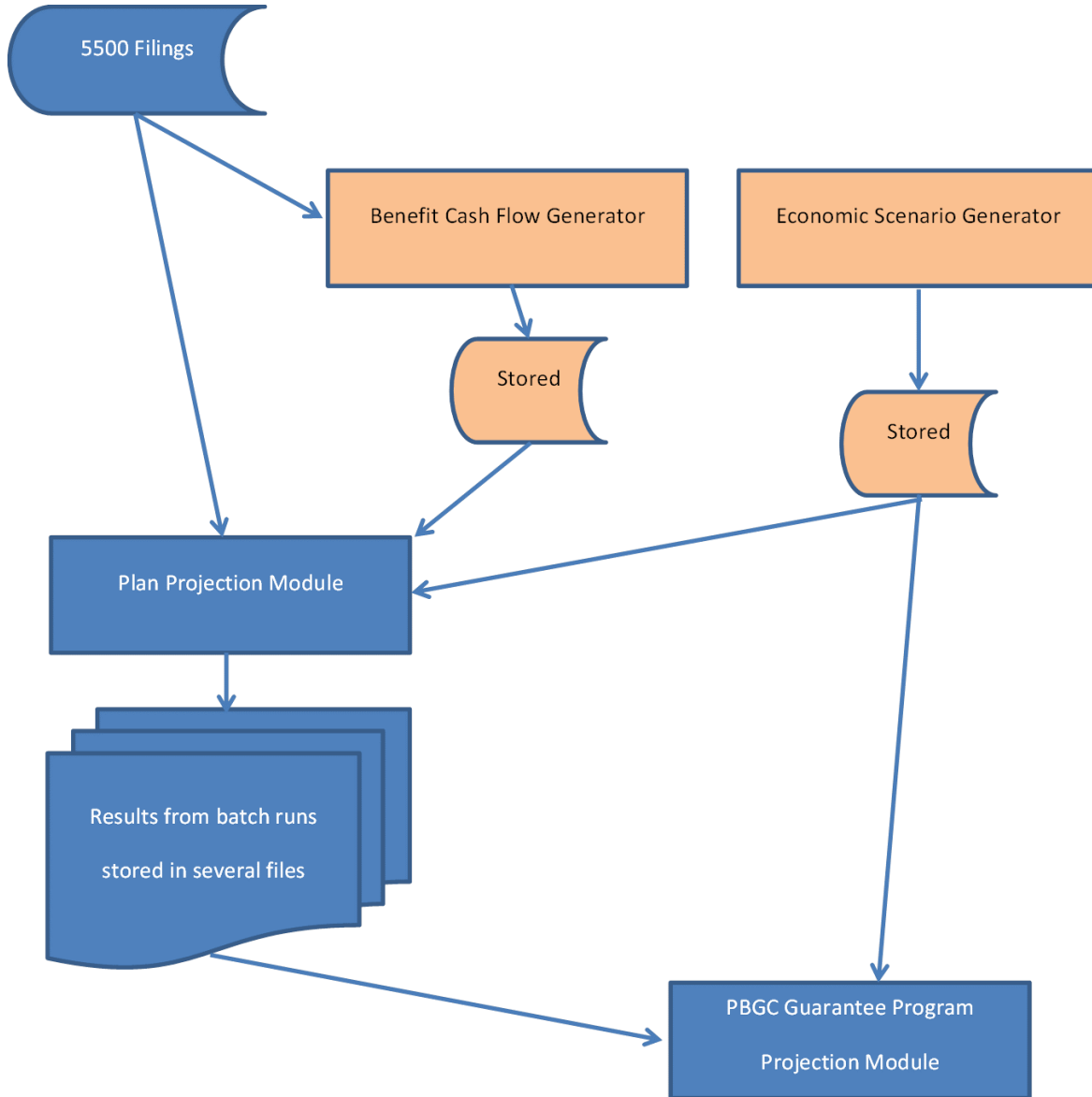


Given the data available, we decided to review the Legacy and Recoded models from a Top-Down and Bottom-Up approach. The next sub-sections describe our analysis under each approach.

## SECTION III -APPROACH AND ANALYSIS
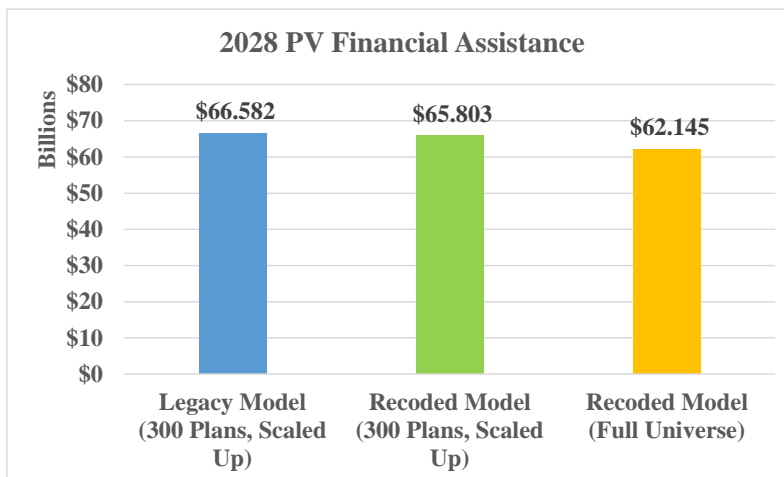
## Top-Down Approach

In the top-down approach, we consider the first part of the process outlined in the prior section – projecting the PBGC's assets and liabilities. The Recoded and Legacy models produced similar Net Positions ($1.8 billion less on 10/1/2028 and $1.2 billion less on 10/1/2018). The differences in the key components are generally explained by the underlying data differences, changes in assumptions, or changes in methods. Overall, the results of the model accurately reflect PBGC's Net Financial Position. See the table below and our commentary and observations on each component that follows.

| $ Billions | Legacy Model | Recoded Model Before Enhancements | Change |
|---|---|---|---|
| **10/1/2028 Values** | | | |
| 1. Assets of PBGC Multiemployer Program | ($4.426) | ($6.987) | ($2.561) |
| 2. PV of projected Partition Payments | $0.160 | $0.217 | $0.057 |
| 3. PV of projected Assistance Payments | $66.582 | $62.145 | ($4.437) |
| 4. Net Position on 10/1/2028 [1. – 2. – 3.] | ($71.168) | ($69.349) | $1.819 |
| **Net Position discounted to 10/1/2018** | ($52.329) | ($51.059) | $1.270 |

## Present Value of Financial Assistance

The graph below shows the differences in the Present Value of Financial Assistance between the Legacy Model, the Recoded Model using the same plans and scaling factors as the Legacy Model, and the Recoded Model using the full universe.

Overall the Recoded Model, based on the same sampling and scaling methodology as the Legacy Model, produces Financial Assistance that is comparable to the Legacy Model. Removing the scaling and adding all of the plans results in a lower financial assistance and is a better reflection of the system.

**2028 PV Financial Assistance**

| | Legacy Model (300 Plans, Scaled Up) | Recoded Model (300 Plans, Scaled Up) | Recoded Model (Full Universe) |
|---|---|---|---|
| Billions | $66.582 | $65.803 | $62.145 |

## SECTION III -APPROACH AND ANALYSIS

**Assets**

The starting point for the value of PBGC's assets is the same in both Legacy and Recoded models at $2.311 billion. The discount rates and asset return parameters appear to be consistent.

The Legacy Model fund projection components are not consistent with Recoded fund projection in several ways.

- The Legacy Model assumes only part of PBGC's assets, labeled "ast_t_bill", gets interest at the discount rate of interest. Premiums and assistance payments counted as part of the assets are not included in this amount. In the Recoded Model, the full portfolio is assumed invested.

- Because the Legacy model does not assume a return on premiums, assets are lower in the Legacy Model than the Recoded Model.

- The income and expense items in the Legacy Model do not match the Recoded Model. Since these items are outputs from the second process, they will be covered in the description of the bottom-up approach in the next section.

**Present Value of Partition Payments**

The difference here is small reflecting the limited resources available for partitions. Also the Recoded Model was knowingly modified to improve the estimate of the cost of partitions.

**Present Value of Projected Assistance Payments**

The numbers behind the present value of projected assistance payments come from the second process and will be covered in the description of the bottom-up approach in the next section. These differences are explained further below, but are ultimately different due to differences in the underlying data, assumption changes, or methodology changes which were generally known and intentional differences.

## SECTION III -APPROACH AND ANALYSIS

**Observations**

As mentioned above, the asset roll-forward in the Legacy and Recoded models are not consistent. We think the Recoded Model roll-forward could be improved upon. Currently the Recoded Model calculates the ending year assets as follows:

Beginning Assets x (1+r) + Premiums x (1+r/2) – Assistance – Partition Payments x (1+r/2)

where r is the return for the year.

PBGC should consider adopting the formula (**changes bold red**)
Beginning Assets x (1+r) + Premiums x (1+ r/**4**) – Assistance **x (1+r/2)** – Partition Payments x (1+r/2) **– Expenses x (1+r/2)**

**Rationale**

The program assumes all plans are calendar year plans, so premiums payable on or before 10/15 are only investable during the last three months of the assumed year. Assistance is paid throughout the year so ought to impact the asset return – a more exact formula could be used to take into account the advanced payment to plans of the assistance.

## SECTION III -APPROACH AND ANALYSIS

## Bottom-Up Approach

The bottom-up approach mainly concerns the second process in getting to PBGC's net position projecting the financial condition of individual plans and any obligations from PBGC resulting from insolvency.

The model is set up with parameters to select an individual plan and an individual economic scenario. There is an automation macro written in Visual Basic so that a plan can be selected and then run through up to 500 pre-input economic scenarios and the results written out to an output file. Because the model produces results in this way, the output can be compared with sample plan output from the earlier Recoded Model and the Legacy Model provided by PBGC. Based on our review of sample plans, the differences were due to the data differences, assumption changes, and method changes. In our opinion, these changes improve the results of the Recoded model.

### Comparison of Results for Specimen Plans for the Legacy and Recoded Model

Because the guaranty program provides assistance once a plan is unable to pay benefits, we concentrated our analysis on sample plans drawn from those that were certified as Critical & Declining with the 2016 5500 Filing. The table below shows the Present Value of Financial Assistance for the five plans. The number is significantly off in three of the five sample plans we reviewed – double for Plan #4, 69% higher for Plan #13, and 20% higher for Plan #14.

| Sample Plan #                               $ Billions | PV FA Legacy | PV FA Recoded | % Change |
|---|---|---|---|
| #1 -- Critical & Declining, 390,000 Participants, Actuary projected insolvency in 2025 | $16,191 | $16,869 | 4% |
| #3 -- Critical & Declining, 100,000 Participants, Actuary projected insolvency in 2022 | $3,749 | $3,993 | 7% |
| #4 -- Critical & Declining, 73,000 Participants, Actuary projected insolvency in 2028 | $1,882 | $3,762 | 100% |
| #13 -- Critical & Declining, 35,000 Participants, Actuary projected insolvency in 2021 | $807 | $1,360 | 69% |
| #14 -- Critical & Declining, 50,000 Participants, Actuary projected insolvency in 2020 | $1,296 | $1,561 | 20% |

## SECTION III -APPROACH AND ANALYSIS

The largest plan had the smallest percentage change, but since the projections for this plan have been given extra consideration and scrutiny by PBGC and because there was much publicly available projection data provided by the plan for an MPRA benefit suspension application, this is perhaps not surprising. While the Legacy Model uses a different base year for the 5500 data for this plan, the Recoded Model uses plan specific investment returns to roll-forward the data to the start of the projection period and then uses a fixed investment return assumption rather than a stochastic approach.

Below we summarize the key differences and similarities:

- The Legacy and Recoded Models sometimes use starting data from different years (a known difference). All Plans in the Recoded Model start with the 2016 Schedule MB data. However, three of the sample plans we were provided from the Legacy Model are based on 2017 MB data (Plan #1, #3, and #4). If a significant event took place in 2016, e.g. a change in industry activity, this would change the projections, but in aggregate this is unlikely to materially affect PBGC's Net Position.

- The models have different methodologies for determining benefit payments and headcounts (a known difference and enhancement to the Recoded Model). The Legacy Model uses the age service scatters attached to the Schedule MB to generate a plan population and also a new entrant vector. These are then used in a valuation system within the Legacy Model to generate the cash flows. In contrast, the Recoded Model relies on fitting benefit payment vectors from known actual plan benefit projections to the current liability numbers in the MB and the expected benefit payments for the starting year (also found on the MB). The headcounts of all plans in the Legacy Model were modeled with a 1.3% per year decline, whereas in the Recoded Model Critical and Declining plans suffer no decline in headcount, and other plans have a stochastic decline with mean of 1.3% and a standard deviation of 8% (although the deviation is limited to +/- 12%).

- Both the Legacy and Recoded models have the same discount rates and asset returns for all plans.

- The Recoded Model uses a fixed investment return assumption for the largest plan (known changes, based on that plan's revised asset allocation this a reasonable change).

- The following table compares key assumptions from the Legacy and Recoded models. All assumption changes were made by PBGC as part of the Recoded model. We reviewed the assumption changes and found them to be reasonable and overall improve the results of the model.

## SECTION III -APPROACH AND ANALYSIS

| | Assumption | Legacy | Recoded |
|---|---|---|---|
| 1 | Active population decline | Average of 1.3% decline per year. Changes from year to year are modeled as autoregressive and have a lognormal distribution. Each plan has a unique random draw for every scenario/year. Variance in percentage changes is smaller for larger plans. Annual changes are correlated with economic simulation. | Same average of 1.3% decline per year. However, changes from year to year are not modeled as autoregressive and has a uniform distribution. Random draws vary across scenario/year but are the same for all plans. Variance is the same for all plans. No correlation with economic simulation. |
| 2 | Contribution Rate increases | Increase based on historical per capita rate, adjusted for FIP/RP and NAWI, PPC increases 7% per year | Same, except Critical & Declining Plans have no increase, PPC increases 3.6% per year |
| 3 | Maximum Contribution Rates | 2 or 3 times 2008 rate (1.5 times for Critical and Declining or ERM plans) adjusted with NAWI | 3 times 2009 rate (1.5 times for Critical and Declining plans) adjusted with NAWI. ERM plans are not modeled in the Recoded model. |
| 4 | Mass Withdrawal Liability assumption at insolvency / Payments Collection | Mass withdrawal upon insolvency, annual payments are assumed to be 40% of prior contribution, no decay | Mass withdrawal upon insolvency, annual payments are assumed to be 43% of prior contribution with a 1% annual decay rate |
| 5 | Actuarial assumptions | Static throughout the projections | Same |
| 6 | Administrative Expense | Maximum of 5% of annual benefit payments | Same |
| 7 | Census and form of payment | 100% male, 100% single life annuity | Assumptions for percent male, females 3-year younger, assumptions for 50% J&S, 80% married for PRDB |
| 8 | Mortality experience | Static RP-2014 combined health male/female tables | Same |
| 9 | MPRA take up assumptions | Not programmed | Not programmed when converted. Later programed 30% for suspension and 10% for partition for FY18 Projection Report model. |
| 10 | Benefit Improvement | Varies stochastically, reflects restrictions for critical and endangered plans | None assumed |
| 11 | Pre-insolvency Mass Withdrawal | Varies stochastically | None assumed pre-insolvency |
| 12 | FIP/RP | Maximum changes occur in the first applicable year (enhanced Recoded Model delays impact by 2-years) | Same |
| 13 | Withdrawal assumptions | None explicitly assumed. However, withdrawal liability payments are included in the per capita contribution rate which implicitly accounts for future regular withdrawal liability payments | Same |
| 14 | New Entrants | Same distribution as starting active population | Same |

## SECTION III -APPROACH AND ANALYSIS

The charts on the following pages compare assets, contributions, and benefit payments between the Legacy Model and the Recoded Model for the eight sample plans (for Scenario 1 out of 500). Following those charts are charts showing the financial assistance payments for the five plans that become insolvent within the first 10 years of the projection.

## SECTION III -APPROACH AND ANALYSIS

**Assets**

Below we show asset projections for the eight sample plans. With the exception of Plan #4, the Recoded Model is consistent with the Legacy Model. Plan #4 had lower contribution and benefit payments, and insolvency was projected farther out in the period. The results of the Recoded Model are in line with the projections prepared by Plan #4's actuary based on the 5500 Filing. See additional explanation in the Contribution and Benefit Payment sections that follow.
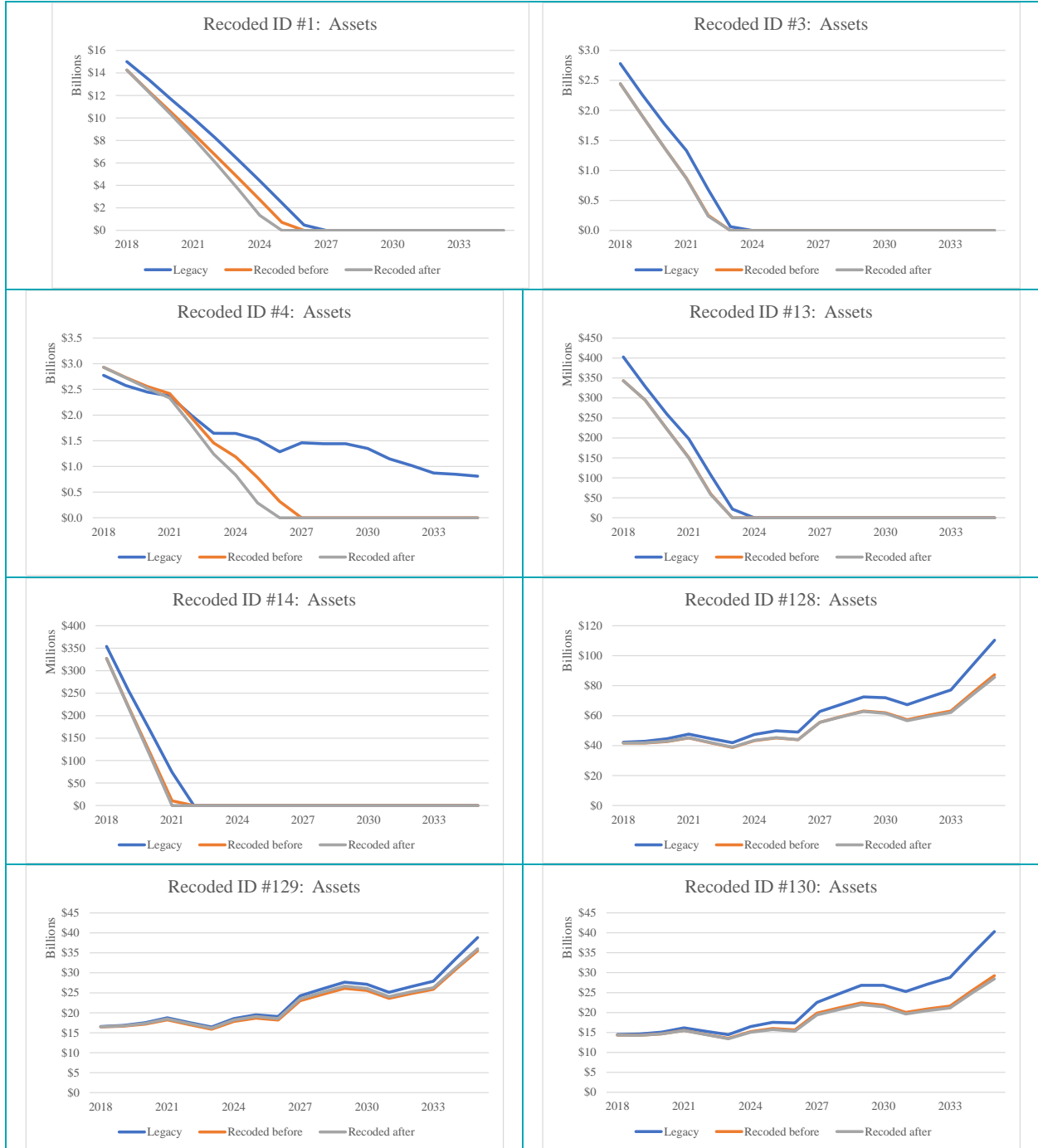
## SECTION III -APPROACH AND ANALYSIS

**Contributions**

Next we show contribution projections for the sample plans. Here is where we see most of the differences due to the contribution assumption changes that were made as part of the Recoded Model with enhancements. Plans #1 and #14 both have similar patterns in the models while Plans #3, #4, and #13 have material differences after insolvency. These are a result of the intentional contribution assumption changes made as part of the enhanced Recoded Model, and in our opinion, are a better reflection of what is likely to happen upon plan insolvency.

The contribution projections for Plan #4 are different because the initial contribution in the Legacy Model includes withdrawal liability payments as part of the employer contributions. This input difference is reflected in the starting per capita contribution rate which is then used for later years. As noted earlier, the per capita contribution increase is higher in the Legacy Model (known assumption change) which causes the contribution projections in the models to diverge. This, combined with the benefit payments, delays insolvency for Plan #4 until after the period shown.

The Recoded Model (with enhancements) made several assumption changes for plan contributions, mass withdrawal, and rate of decay and a different algorithm for timing of mass withdrawal. In our opinion, these are reasonable and appropriate. The changes are listed below (see PBGC's Multiemployer Spreadsheet Model FY 2019 Release dated 11/19/2019 for more information).

- Plans that fall into Endangered status under PPA during the projection are assumed to have 12% annual increases for the next 10 years. The model was adjusted to have the increases be delayed for two years. A delay is common in practice as increases generally do not occur until the next round of collective bargaining, so this change is reasonable. This lowered the Net Position by $0.4 billion.

- Adjustment to the withdrawal liability payment period (rounding impact on the Net Position).

- Adjustment to the Per Capita Contribution Cap programming to avoid having the amount reset during the projection. This mainly affected large green-zone plans and improved the Net Position by $3.5 billion.

# SECTION III -APPROACH AND ANALYSIS



Recoded ID #1: Contributions



Recoded ID #3: Contributions



Recoded ID #4: Contributions



Recoded ID #13: Contributions



Recoded ID #14: Contributions



Recoded ID #128: Contributions



Recoded ID #129: Contributions



Recoded ID #130: Contributions

## SECTION III -APPROACH AND ANALYSIS

**Benefits**

Next we show benefit payment projections for the sample plans. The solid lines represent benefits paid from the plans before (full plan benefit) and after insolvency (at PBGC Guarantee). The dotted lines (only available for the Recoded Model) are the full plan benefits that would have been paid absent the PBGC Guarantee. We showed these to illustrate the impact of the reduction, which in our opinion is appropriate.

All plans, with the exception of Plan #4, have projected benefit payments that are consistent between models. Similar to the contributions, Plan #4 benefit payments are different because the starting data was different. This affects the development of the entire stream of payments. The lower benefit payments in the early part of the projection allow the plan to remain solvent over the period shown compared to the Recoded Model.
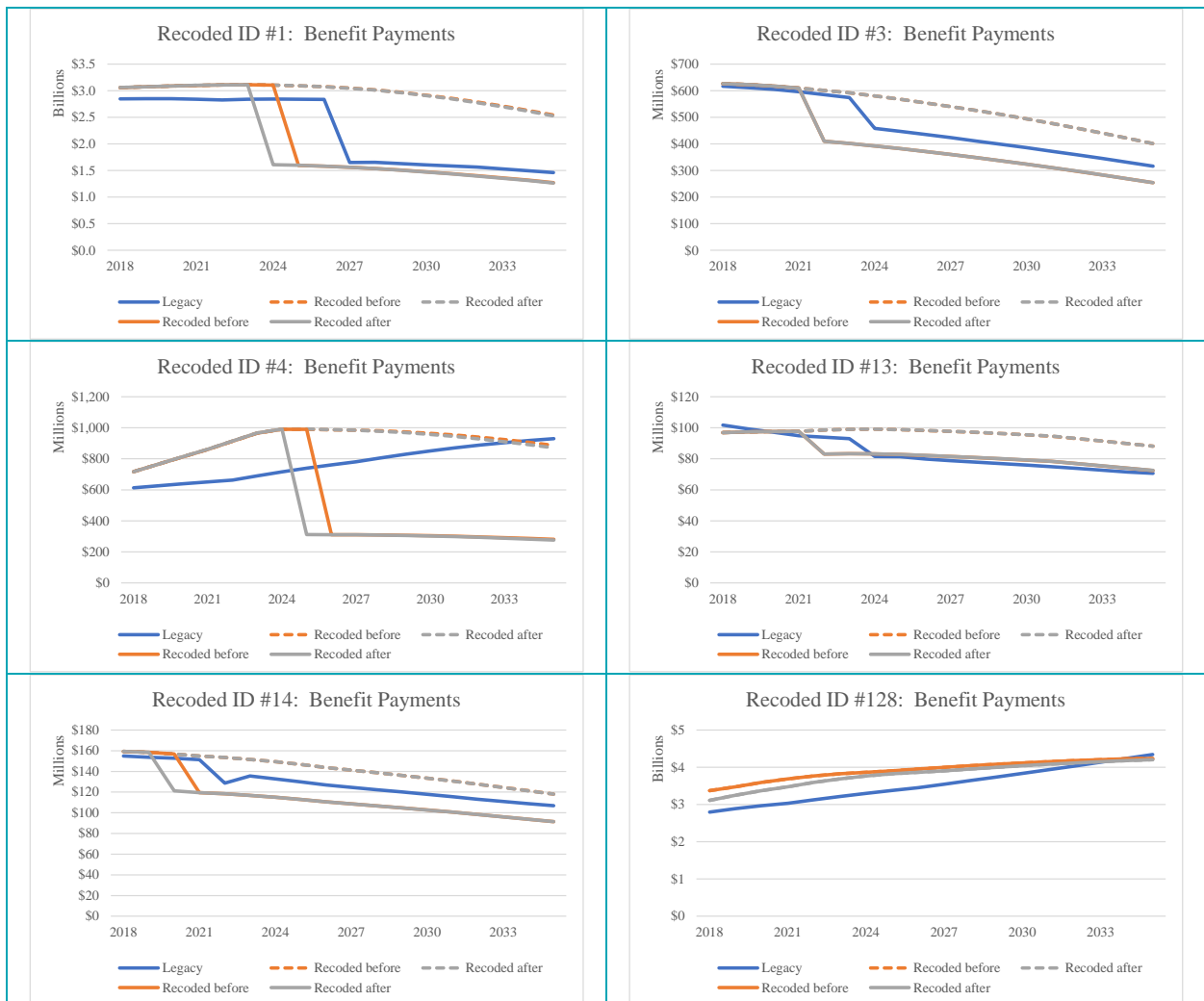
## SECTION III -APPROACH AND ANALYSIS



Recoded ID #129: Benefit Payments



Recoded ID #130: Benefit Payments
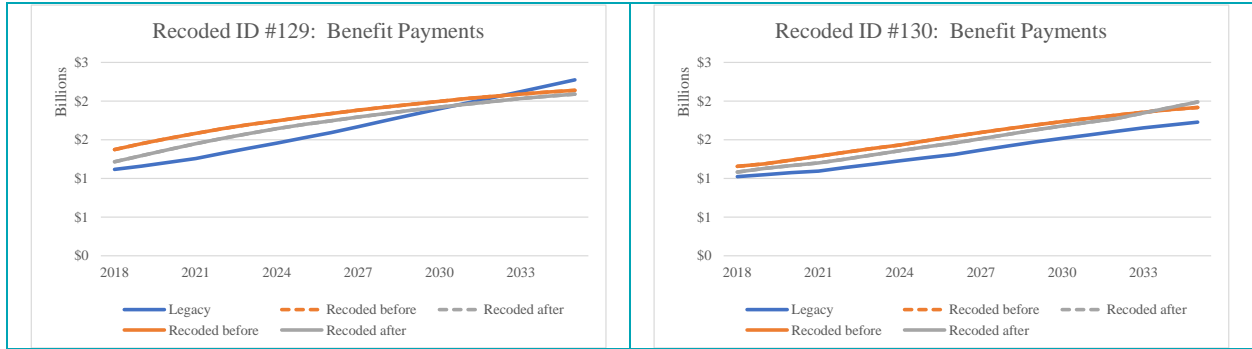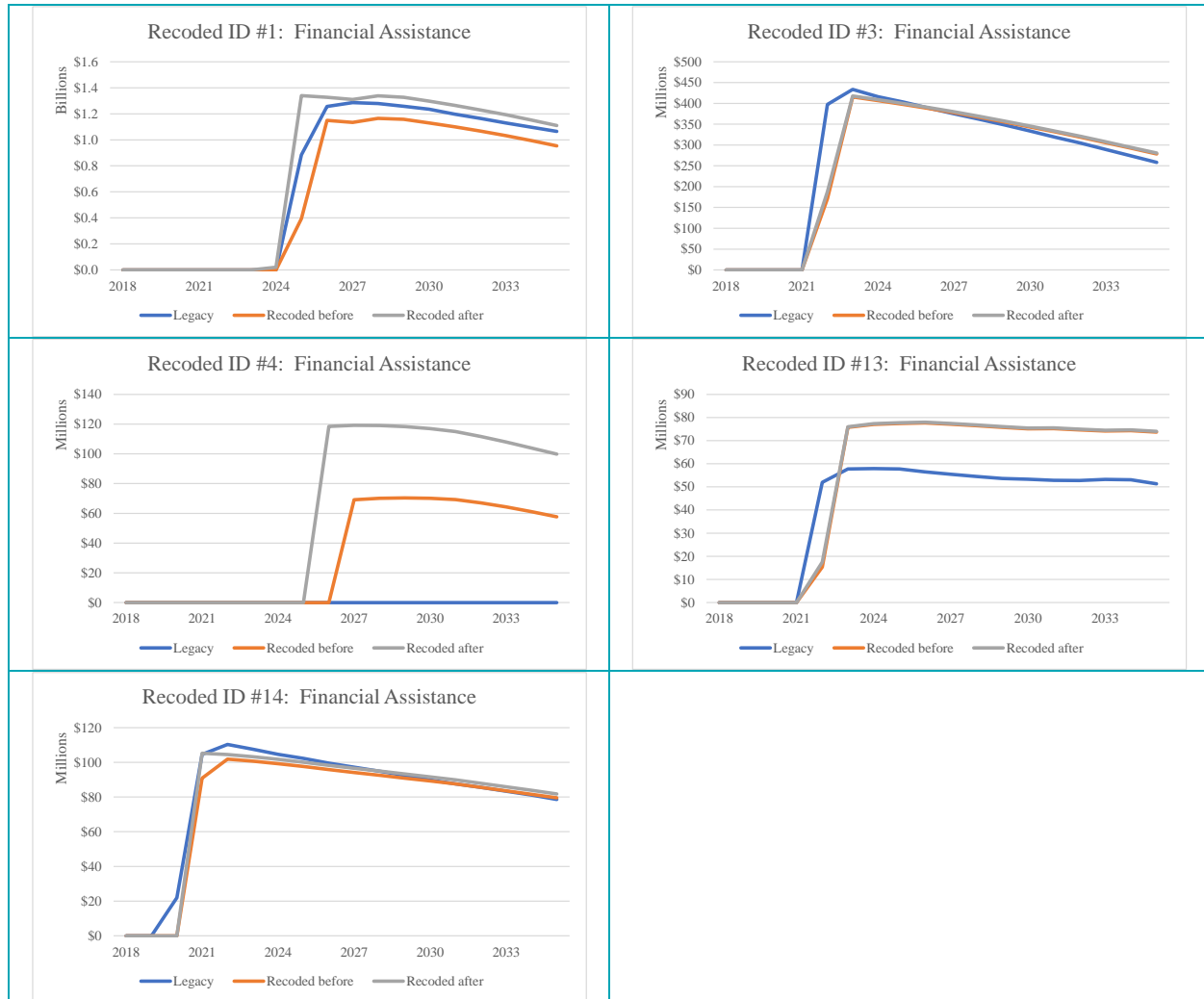
## SECTION III -APPROACH AND ANALYSIS

### Financial Assistance (5 plans)

Finally, we show projected financial assistance for the five sample plans that are projected insolvent. Plans #1, #3, and #14 are consistent between models. The deviation for Plans #4 and #13 is a result of the different contribution assumption that we showed earlier.

## SECTION III -APPROACH AND ANALYSIS

# Observations on the Recoded Model

These observations relate to the Recoded Model with respect to the plan level projections only (the second process). Observations on the projecting PBGC's assets and liabilities (the first process) are discussed earlier.

## Pre-Projection Roll-Forward

While the model is complex, the output relies heavily on a number of assumptions and approximations. In the Recoded Model, the assumption is made to treat all plans as having a calendar year for their plan year and for the PBGC's measurement date to coincide with that year. With the Recoded plan taking 2016 Form 5500 data as its starting point, the model first projects the plan to the 1/1/2019 measurement date (a proxy for a 10/1/2018 measurement date). Since this three-year period is already over, the investment market performance is known; therefore, the projection uses one set of investment return assumptions for 2016, 2017 and 2018. With the exception of the largest plan that is soon projected to become insolvent, the actual returns used are 7.42% for 2016, 13.98% for 2017, and 3.71% for 2018. The average returns are appropriate for calendar year plans with a 60/40 asset mix. However, not all plans have the same investment return assumption or asset allocation, and only 60% of plans weighted by assets are calendar year. PBGC may consider modifying the returns for this purpose to choose returns that take into account the assumed rate of return and plan year. However, we do not anticipate this refinement to change the Net Position when rounding to the nearest 0.1 billion.

## Projection

### *Contributions – Bargained Employer Contributions, Withdrawal Liability Payments and Mass Withdrawal Liability Payments*

The solvency projection depends on assumptions made as to the level of employer contributions and withdrawal liability payments for already withdrawn employers. As documented in the model material provided, this is a difficult variable to program using the Form 5500 data because the inputs often include withdrawal liability payments. The input issue aside, we agree with the methodology used in the roll-forward of employer contributions which is done on a per capita basis while the plan is solvent and limited to 150% of the 2009 level with inflation. The model uses different per capita increase assumptions depending on the plan's zone status, but increases are not below the National Average Wage Index. Endangered plans approximate the increase under the Funding Improvement Plan, and Critical plans approximate the increase under the Rehabilitation Plan. Plans in "Safe" status have their per capita contribution set equal to the plan's actual per capita increase since 2009, but phased down to the National Average Wage Index over 15 years.

Ultimately, the employer contributions are equal to the annual per capita contribution multiplied by the annual active membership count. The active count is stochastically modelled as noted previously.

## SECTION III -APPROACH AND ANALYSIS

A different approach to contributions is taken for Critical and Declining status plans. For these plans, the headcount and the contribution rate is kept level, the overall assumption being that the plans will maintain a level total employer contribution until insolvency occurs. We recommend this assumption be reconsidered since Critical and Declining plans typically have declining headcounts.

Once a plan becomes insolvent, the model assumes a mass withdrawal occurs. The model allows the user to input an assumption of how the mass withdrawal payments relate to the pre-mass withdrawal regular contributions and also input a decline assumption. The Recoded Model sets the withdrawal liability collection percentage at 43% with a 1% annual decline. We tested the sensitivity of this assumption by running all plans through the first five trials using the Recoded Model with enhancements and comparing the impact on the 2028 Present Value of Financial Assistance. With a 10% higher (or lower) initial collection percentage, the Present Value of Financial Assistance was approximately 5% lower (higher) a change in the reported PBGC net position at 9/30/2018 of about $3 billion.

### *Benefit Payments – Before and After Insolvency*

The next key component of the solvency projection is the plan benefit payments. This may arguably be the most important projection item in the model since it is used for the solvency projection and is used in the development of the PBGC guaranteed benefit payments, which determines the Net Position. The model pulls the benefit streams by participant status, both at the full plan benefit level and at the PBGC Guaranteed Benefit level, that were calibrated outside the model (see tabs CalibInactCF and CalibActCF).

PBGC may consider an independent review of the model used to create the benefit payment vectors (which was outside the scope of this project) and how alternative benefit streams would affect the Net Position. The fitting of payment vectors to match the liability values and expected first year benefit payments is not a novel idea, and we have used various techniques in our own work over the years.

We note that the model recalibrates the active accrued benefit input vector so that the present value of the payments equals the active current liability value shown in the Form 5500 database, but there is no similar recalibration of the retiree or deferred vested vectors. While we would expect no recalibration to be required for any of the vectors, the changes observed were minor.

We recommend the calibration should take into account the 10-year benefit payment stream that was required to be attached for the Form 5500 beginning for the 2018 plan year.

### *MPRA Partitions and Suspensions*

The full plan benefits are adjusted for Partition if applicable. However, the partition adjustment is only necessary until the plans file a Form 5500 with the partition reflected, otherwise the program would double-count the partitioned off benefits. Furthermore, for Partition, we noticed that Plan ID #53, which was granted partition during 2017, still has full benefit payments used in the initial projection to the start year. The model does not reflect the Partition until Plan Year 2020. The model only has three plans programmed with Partition so the impact of this change will be minor and is unlikely to move the Net Position when rounded to the nearest $0.1 billion given that partitioning is expected to result in troubled plans avoiding insolvency. If more plans are approved for partition, this could have greater impact, and we suggest the programming be updated to reflect the partition effective date.

## SECTION III -APPROACH AND ANALYSIS

The model includes 11 plans approved for MPRA Suspension of Benefits and makes adjustments for the suspended level of benefits. As noted with Partition, we think this methodology is appropriate until these plans file a Form 5500 reflecting the adjustment, unless PBGC is taking this into account in the models used to establish the benefit payment vectors. Also, the model calculates a Weighted MPRA Percentage which applies to all participant statuses even though the inputs are available to do this by status. However, as with Partition, a Suspension is aimed at avoiding insolvency so Suspension plans should not materially add to PBGC's net position.

*Expenses*

We confirmed the programming for administrative expenses is appropriate. The initial amount is pulled from the Form 5500 and projected forward with 2% inflation, but limited to 5% of benefit payments. However, we found a very minor formula error in cell J94. The formula compares the greater of: 1) the prior year expenses increased by 2% inflation, but as a negative number and 2) expenses as a percentage of benefit payments, but as a positive number. With the signs off, the second will always be greater. Again, this is a very minor change in only one year and should have no effect on the Net Position rounded to the nearest $0.1 billion.

*Stochastic Trials*

We tested the reasonableness of the stochastic process in the Recoded model by reviewing the output from the 500 stochastic trials for the five sample plans that are expected to go insolvent. The table below summarized the probability of insolvency through 2038. With the fixed investment return assumption for Plan #1, it is appropriate for there to be 100% probability. However, the variability in investment returns for the other plans shows how insolvency will vary over time. Plans #3 and #13 have a higher probability of insolvency in the short term, while Plans #4 and #14 have a 50% change to have insolvency delayed until after 2038. These results are in line with our expectations.

| Recoded ID: | #1 | #3 | #4 | #13 | #14 |
|---|---|---|---|---|---|
| Probability of Insolvency | | | | | |
| None | 0.0% | 0.0% | 0.0% | 0.2% | 0.0% |
| 2018 to 2022 | 0.0% | 72.2% | 0.0% | 61.8% | 0.2% |
| 2023 to 2027 | 100.0% | 20.6% | 25.2% | 29.6% | 25.0% |
| 2028 to 2032 | 0.0% | 5.6% | 11.2% | 5.0% | 11.2% |
| 2033 to 2037 | 0.0% | 1.6% | 11.0% | 2.8% | 11.0% |
| 2038+ | 0.0% | 0.0% | 52.6% | 0.6% | 52.6% |
| | 100.0% | 100.0% | 100.0% | 100.0% | 100.0% |

## SECTION III -APPROACH AND ANALYSIS

To illustrate this further, the graphs that follow compare the Financial Assistance for 25 of the 500 trials; the average is shown as the dotted black line. Similar to the above table, this shows the random outcomes that can occur under different economic scenarios. Plan #1 has all 25 trials in the same shape due to the fixed investment return assumption. However, the other four plans show the variability in outcome. With Plans #3 and #13 having a near-term expectation of insolvency, it is expected that their 25 trials would show a tighter dispersion of assistance payments than Plans #4 and #14 with their more distant expectations of insolvency. The charts below confirm this expected pattern.
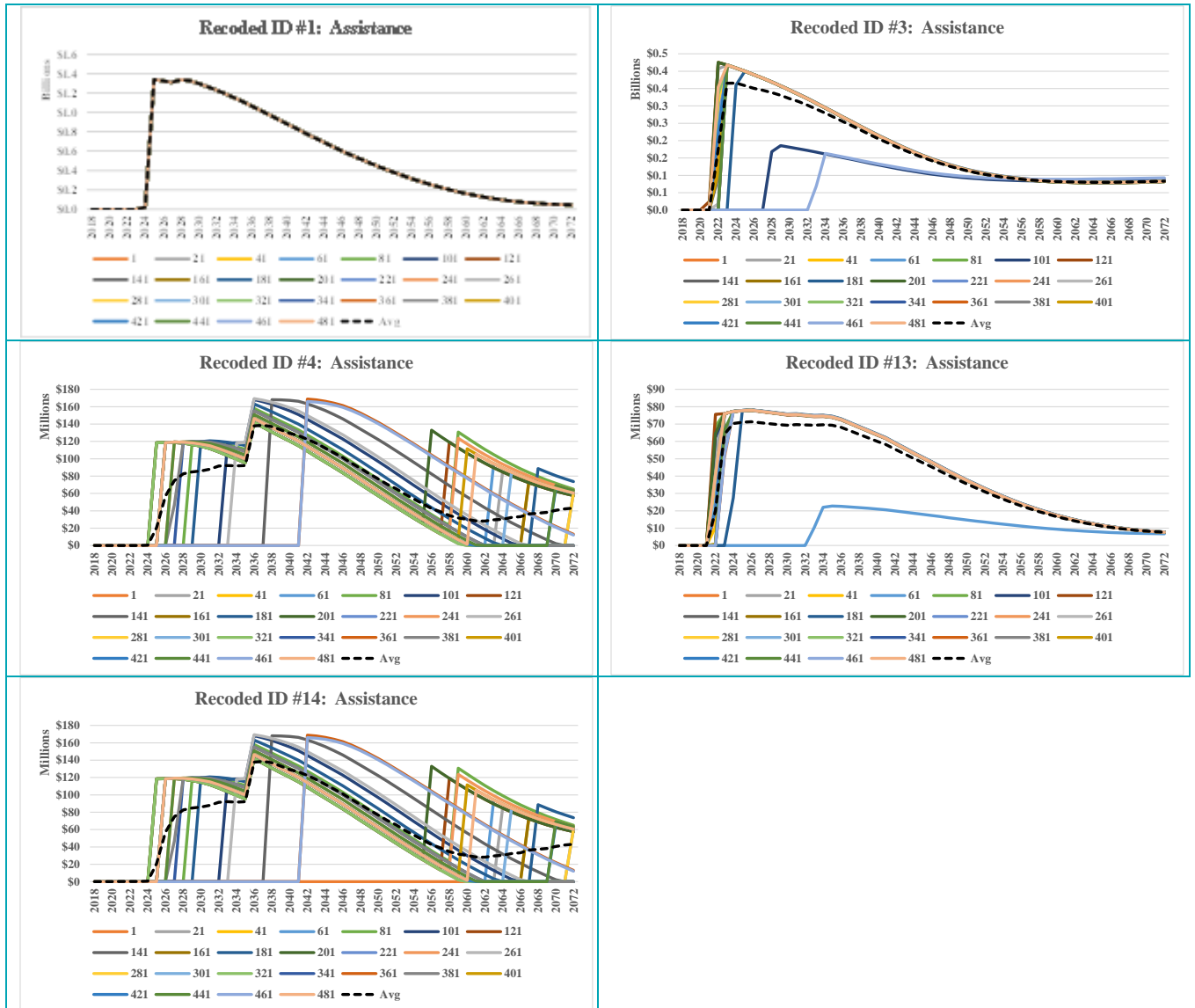
## SECTION IV - CONCLUSIONS

Based on our review, we have determined that, while the Legacy and Recoded models are different, the Recoded Model includes enhancements and refinements and produces results that are an appropriate reflection of the Multiemployer Pension universe and PBGC's Net Position.

A summary of our response to each of the key objectives is shown in the table below.

| Key Objective | Response |
|---|---|
| Confirm the methodologies used to develop cash flows, liabilities, and other pertinent calculations are performed consistent with multiemployer program provisions. | Based on our review and understanding of the model, we have confirmed the model is consistent with multiemployer program provisions. |
| Identify changes in methods and assumptions from the Legacy model by comparing outcomes and evaluate whether those changes are likely to improve the results of the modeling. | Changes in methods and assumptions were identified and summarized in Section II and in our opinion have improved the results of the model. |
| Review actuarial calculations in the Recoded Model to assure accuracy. | Based on our review, the Recoded Model is following the funding rules laid down by ERISA closely enough for the purposes of the projection. |
| Summarize findings and provide recommendations to address those findings based on the results of the review. | This report serves to summarize our findings and recommendations. |