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Research Paper

Provisions for Adverse Deviations in Going Concern Actuarial Valuations of Defined Benefit Pension Plans

Task Force on the Determination of Provisions for Adverse Deviations in Going Concern Valuations

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Memorandum

To: All Pension Plan Practitioners

From: Bruce Langstroth, Chair
Practice Council

Stephen Bonnar, Chair
Task Force on the Determination of Provisions for Adverse Deviations in Going Concern Valuations

Date: January 21, 2013

Subject: **Research Paper: Provisions for Adverse Deviations in Going Concern Actuarial Valuations of Defined Benefit Pension Plans**

The purpose of this research paper is to provide background for the actuary when developing (or in assisting plan sponsors and administrators in developing) provisions for adverse deviations (PfAD) in going concern pension plan valuations. This paper is directed at pension actuaries, and its main objective is to assist them in answering the following type of question: "With a PfAD of x% in a fully funded plan, what is the probability that the plan will still be fully funded at some future date?"

In accordance with the Institute's Policy on Due Process for the Adoption of Guidance Material Other than Standards of Practice, this research paper has been approved by the Task Force on the Determination of Provisions for Adverse Deviations in Going Concern Valuations, and has received approval for distribution from the Practice Council on January 17, 2013.

If you have any questions or comments regarding this research paper, please contact Stephen Bonnar at his CIA Online Directory address, spbonnar@gmail.com.

BL, SB

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I. INTRODUCTION

The genesis of this research paper dates back to 2004 and 2005 when the Canadian Institute of Actuaries (CIA) released the Final Report of the Task Force on Public Policy Principles of Pension Plan Funding and a Statement of Principles on Revised Actuarial Standards of Practice for Reporting on Pension Plan Funding. These principles represented a shift in approach whereby appropriate levels of provision for adverse deviations (PfADs) under going concern actuarial valuations would be determined in relation to a funding policy adopted by the pension plan sponsor (or administrator as appropriate) rather than being imposed by actuarial standards. Indeed, the Standards of Practice – Practice-Specific Standards for Pension Plans issued in June 2010 require the actuary performing a going concern valuation to "select either best estimate assumptions or best estimate assumptions modified to incorporate margins for adverse deviations, to the extent, if any, required by law or by the terms of an appropriate engagement".

In recent years, low interest rates and periods of volatile pension fund investment returns have had a significant negative impact on the financial status of pension plans. Pension plans where minimum statutory contributions are based on both the going concern and solvency valuations are typically underfunded on a solvency basis (despite increased contributions). A number of plans have wound up in a deficit position, resulting in benefit reductions for the plan participants. Pension plans where minimum statutory contributions are not affected by the solvency valuation may have reduced margins and/or been required to implement accrued benefit reductions. This economic climate and the large contributions required to be made to pension plans have encouraged pension plan stakeholders to seek solvency funding relief of different forms. To varying extents, the individual pension jurisdictions have accepted the arguments of these stakeholders and relief measures have been implemented to mitigate the adverse impact of solvency funding requirements.

From a public policy perspective, given the changes in actuarial standards, pension regulators have expressed a need to develop guidance in respect of appropriate levels of PfADs. Notwithstanding the alleviation of solvency funding requirements noted above, such requirements, which are intended to enhance the benefit security of plan participants, continue to impose a significant funding burden on sponsors of traditional single employer defined benefit pension plans; for such plans it is likely that any PfAD under the going concern valuation would interact with the solvency funding requirements in determining statutory minimum contributions. In contrast, for plans such as multi-employer pension plans (MEPPs) and other target benefit plans, additional funding requirements typically result in lower benefits rather than increased contributions. Accordingly, this research paper focuses on MEPPs and target benefit plans where any PfAD under the going concern valuation would be expected to play a greater role in benefit security than it would for a single-employer pension plan.

At the onset it was recognized that the development of guidance would require the investment of significant resources. In 2009, Alberta Finance contacted the CIA to seek assistance in the development of PfAD guidance and committed to assist in the funding of the research initiative. Additional resources were secured from the CIA's research budget and the Canadian Association of Pension Supervisory Authorities (CAPSA) became formally involved. This led to the formation of the Task Force on the Determination of Provisions for Adverse Deviations in Going Concern Valuations.

The task force is mandated with the preparation of this research paper on the determination of PfADs for going concern valuations of defined benefit plans where minimum statutory contributions are not affected by a solvency valuation. This paper provides an analysis of the

PfADs required to achieve specified levels of benefit security over specified periods of time with various levels of probability, given various investment policies and economic scenarios.

The task force was also charged with the development and issuance of a request for proposals (RFP) to select a provider to complete the necessary stochastic modelling under its direction. Due to limited budgetary resources, it was initially expected that the selected provider would be required to furnish their services at below market rates.

Before the issuance of the RFP, the Ontario Teachers' Pension Plan (OTPP) was approached in respect of the project and it generously offered the task force access to its internal software and manpower resources on a pro bono basis. The task force is very appreciative of this offer and wishes to thank the OTPP formally for its contributions to this research paper.

II. BACKGROUND

The task force needed to consider a number of issues in deciding on its approach to determining PfADs for going concern valuations:

- What is the goal of a PfAD in a going concern valuation?
- What are the limitations of using a PfAD in a going concern valuation?
- What is the role of the actuary?
- How will decision makers select the level of PfAD?

Goal of a PfAD

Pension plan funding has a main goal of security of benefits for plan participants. Additionally, plan funding may also have a goal of achieving stable benefit levels or contributions over time. A "fixed" PfAD (as a percentage of actuarial liabilities, for example) can enhance the security of plan benefits in a typical single-employer pension plan by increasing the amount of assets in the pension fund relative to the contractual obligations. Alternatively, in a plan such as a MEPP, where contributions are fixed, a fixed PfAD would reduce the contractual benefit. A "variable" PfAD, one that increases or decreases as plan experience is favourable or unfavourable, respectively, can enhance the stability of plan benefits or contributions.

For the purposes of this research paper, the task force chose to focus on a target level of PfAD that would achieve certain funding objectives (e.g., 75% likelihood of being 100% funded in three years). In the context of a plan where minimum statutory contributions are not affected by a solvency valuation, this approach is akin to a variable PfAD.

Limitations of a PfAD in a Going Concern Valuation

For many plans, the solvency valuation is the main driver of contributions. Additionally, some jurisdictions require a margin in the solvency valuation before allowing contribution holidays. For plans where minimum statutory contributions are not affected by a solvency valuation, any PfAD in the going concern valuation, while enhancing benefit security, would not necessarily be sufficient to ensure that all accrued benefits could be covered were the plan actually to wind up.

Many plan sponsors have little interest in using PfADs to manage the volatility of their contributions because of the uncertainty of accessing these "supplementary contributions" if they prove unnecessary over time. Administrators for multi-employer pension plans are constrained in adopting PfADs because of the detrimental impact on benefit levels (i.e., a greater certainty of a lower benefit).

The Role of the Actuary

The actuary must comply with actuarial standards and relevant legislation. As pointed out in the Introduction, actuarial standards do not require the actuary to use PfADs unless specified by the terms of the engagement or by applicable legislation.

The actuary may also assist plan stakeholders by providing analyses of the consequences of using different levels of PfADs. These consequences may affect either or both of the security of plan benefits and the volatility of plan contributions/plan benefits.

For purposes of this research paper, the task force believed it was important for an actuary to be able to answer the following type of question: With a PfAD of x% in a fully funded plan, what is the probability that the plan will still be fully funded at some future date?

Selecting the Level of PfAD

Decision makers may look at several factors in choosing the level of PfAD:

- The financial strength of the entity taking contribution risk;
- The risk tolerance of plan stakeholders;
- The uncertainty of future plan experience;
- The appropriate time horizon for consideration;
- The maturity of the plan's liabilities; and
- The asset mix of the plan.

For purposes of the financial modelling, the task force has not considered the first two items above as they will be specific to each individual pension plan.

III. RESEARCH METHODOLOGY

The actuarial staff of the OTPP assisted the task force with the stochastic modelling for this research. Frequency distributions of future assets and liabilities of a typical flat-benefit MEPP[1] were generated from an asset and liability simulation model maintained by the actuarial staff of OTPP. The integrated OTPP asset and liability model was parameterized to enable projections based on a number of asset allocation alternatives, plan maturity variables, and valuation techniques.

The focus of the OTPP modelling was on developing frequency distributions of funded ratios in each of the 15 years of the projection period. The frequency distributions of the funded ratios were determined from the results of 1,000 equally likely stochastic simulations of the market value of the MEPP assets and the actuarial liabilities. The market value of the initial MEPP assets was set equal to the actuarial liability evaluated at the beginning of the projection period.

The frequency distribution of the market value of the MEPP assets was developed from the stochastic OTPP Asset Model maintained by OTPP based on economic variable input agreed with the task force. The task force reviewed the output from the OTPP Asset Model and confirmed that the return distributions over the 15-year projection period were consistent with similar input and output from other economic models in use in Canada.

[1] While the modelling was conducted on a flat-benefit plan, it would be expected that similar results would be obtained with a career-average plan. However, it would also be expected that the level of PfAD for a final average earnings plan (or a plan with contractual indexing) would need to be larger (all else equal) to reflect the additional inflation risk in the liabilities.

The frequency distributions of future funded ratios were analyzed to evaluate the funded ratios at the 10th and 25th percentiles of the frequency distribution.

The analyses were performed for:

- A range of different asset allocation alternatives;
- Various degrees of plan maturity; and
- Two approaches to determining the discount rate for developing liabilities and current service costs.

Further details are provided in appendix A.

IV. COMMENTARY

Detailed tables of the results of the projections are contained in appendix B. The purpose of this section is to provide some high-level commentary on the results. This commentary will focus on a plan with the following characteristics:

- 50% of the liabilities are in respect of pensioners;
- Asset mix is 60% equities and 40% long bonds;
- The discount rate is set at each valuation to reflect changes in long bond yields since the last valuation;
- The time horizon is three years (i.e., period to next valuation); and
- The funding objective is to be 75% certain of being fully funded at the end of the time horizon.

Together with other assumptions described elsewhere in this report, our analysis indicates that a PfAD of 8% of the liabilities (measured on a best estimate basis) will achieve this funding objective. The following table provides a sensitivity analysis of independent changes to the assumptions noted.

Item	Change in Assumption	PfAD
Maturity	25% of liability for pensioners 75% of liability for pensioners	8% 7%
Asset mix	40% equities 80% equities	6% 10%
Bond duration	Universe bond index	11%
Probability of full funding	90%	20%

Actuaries have frequently used a margin in the discount rate to build a PfAD. A margin of around 50 basis points is common and may well result in a PfAD of 8% for a plan with a typical maturity profile. However, such a margin may be insufficient to achieve the 75% probability target for plans with an equity content higher than 60% and for plans where the bond portfolio consists of universe bonds (because universe bonds have a shorter duration than the typical pension liability).

The task force notes that while the PfADs have been expressed as a percentage of best estimate actuarial liabilities, there are a variety of approaches to implement them. For example, if the sum

of a plan's current service cost, administration allowance, and special payments is $1,000,000 per year, and the plan's contributions are $1,200,000, there is $200,000 of unallocated contributions. The present value of these unallocated contributions over a period of years represents a type of PfAD.

The task force also notes that the levels of PfAD shown in this report should be considered as "target" levels (given a particular funding objective). Various mechanisms could be used to manage actual levels of PfAD toward these targets. It is beyond the scope of this paper to explore such mechanisms.

Appendix A specifies which variables/assumptions are stochastic and which are deterministic. Generally, the investment returns and liability discount rates are stochastic, and all the other assumptions are deterministic. The PfADs that have been developed take into account variation in experience with respect to the stochastic items only. Adverse experience with respect to the demographic assumptions is not incorporated into the PfADs.

V. CONCLUSIONS

The results of the analysis underlying this research paper (as set out in appendix B) will enable actuaries to address the question indicated earlier in this paper, namely: "With a PfAD of x% in a fully funded plan, what is the probability that the plan will be fully funded at some future date?"

The results of this analysis will also help actuaries to give guidance on the level of PfAD that is consistent with the funding policy of the plan sponsor. Regulators should find the results of this analysis useful in selecting the level of PfAD to be stipulated in legislation or regulatory guidance. Further, the results of the analysis will enable actuaries and regulators to assess how risk might be factored into the determination of the level of appropriate PfADs.

The summary output in appendix B reports the level of PfAD that is consistent with a plan being fully funded with 75% and 90% probabilities (the 25^{th} and 10^{th} percentiles of the distribution of funded ratios).

The output in appendix B is further differentiated by:

- Allocations to equity investments ranging from 20% to 80% of the portfolio years;
- Allocations of fixed income investments to universe bonds versus long-term bonds;
- Plan maturity measures ranging from a plan with no retirees to a plan with liabilities from retired members being 75% of the total liabilities; and
- Going concern actuarial valuations at durations three, five, 10, and 15.

In all of the projected going concern actuarial valuations, the discount rate was established on a best estimate discount basis applicable in the economic environments of each simulation. The technique for simulating the initial and subsequent discount rates is described in appendix A.

The summary output in appendix B confirms and quantifies the sensitivity of the indicated PfAD to the asset allocation policy of the plan. The table in section IV illustrates this sensitivity for a plan with 50% of the liabilities attributable to retired members. The indicated PfADs are particularly sensitive at the 10^{th} percentile and more sensitive when the fixed income component is all allocated to universe (or market duration) bonds.

APPENDIX A – DETAILS OF METHODOLOGY

Asset Model Description

The actuarial staff of the Ontario Teachers' Pension Plan described the OTPP Asset Model as follows:

"***Ontario Teacher's Pension Plan***

Asset Model – Description

The Ontario Teacher's Pension Plan proprietary Asset Model is based on a regime-switching framework that can simulate asset returns and yields under four distinct inflation regimes:

1. ***Stagflation***
2. ***Disinflation***
3. ***Stable inflation***
4. ***Deflation***

Within this framework, the forecasted asset returns and yields bear regime-specific characteristics such as average returns, volatility and correlations identified by the analysis of historical data. Inflation has been chosen as the key indicator for regime identification because of the well-known relationship between asset performance and inflation.

The key macroeconomic inputs to the asset model are the potential GDP growth, inflation and exchange rates. These variables are the most important long-term drivers of asset returns and bond yields and will be used as the primary influence on a cascade of relationships between asset class returns and yields."

Because PfADs will be selected at various dates in the future and under varying economic conditions, the asset projections were developed on a "trendless" basis. That is, **average** levels of inflation and bond yields were assumed to remain constant over time. Of course, the projections reflect significant variation from these average levels.

Asset Allocations

- The asset portfolio was comprised only of publicly traded equities and Canadian bonds;
- The equity allocations were limited to Canadian, U.S., and EAFE equities;
- The composition of the equity portion of the total portfolio was fixed at:
  - Canadian equities 50%
  - U.S. equities 25%
  - EAFE equities 25%;
- Total equity allocations of 20%, 40%, 60%, and 80% of the portfolio were modelled;
- Residual bond allocations were comprised of either universe or long bonds for each of the equity allocation alternatives; and
- The composition of the residual universe bond allocation was fixed at their proportions in the DEX Universe Bond Index as at January 1, 2011:
  - Short-term 48.3%
  - Medium-term 24.6%
  - Long-term 27.1%.

Degrees of Plan Maturity

The OTPP Asset Model enabled projections reflecting the impact of varying degrees of plan maturity. The degrees of plan maturity were manifested by altering the proportions of the retired liability to the total liability, as follows:

- No retired members;
- Retired member liabilities equal to 25% of total plan liabilities;
- Retired member liabilities equal to 50% of total plan liabilities; and
- Retired member liabilities equal to 75% of total plan liabilities.

Actuarial Valuation Techniques

The liabilities were projected for each of the 15 years of the projection period with new entrants replacing exits from the active membership each year.

The actuarial liabilities and current service costs were developed using the projected unit credit valuation method with the discount rate determined in two ways:

- Variable discount rate determined on a best estimate basis consistent with the applicable asset allocation policy:
  - Discount rate was set equal to the long Canada bond yield applicable at the valuation date (actual for January 1, 2011, and simulated for subsequent valuations), plus a credit spread of 0.75%, plus an equity risk premium of 3% multiplied by the total equity allocation percentage. The resulting discount rates as at January 1, 2011, ranged from 5.95% for the 80% equity allocation to 4.15% for the 20% equity allocation.
- Fixed discount rate[2] of 6% for the January 1, 2011, and subsequent valuations.

At the beginning of the projection period the MEPP assets were set equal to the actuarial liability. The contributions remained fixed at the level of the normal current service cost that was determined in the initial actuarial valuation. No contribution increases or decreases were reflected in subsequent actuarial valuations.

Expenses

The modelling reflects combined administration and investment expenses of 80bps in each projection year, which were assumed to be met from plan assets.

Multi-Employer Pension Plan and Data

The modelling is based on seriatim active and retired member data supplied by the task force. This data was considered by the task force to be representative of conventional MEPPs in Canada. This MEPP is a defined benefit pension plan (flat benefit) where contributions from the participating employers are fixed until higher contribution levels are negotiated between the representatives and the applicable employer. The provisions of the MEPP include:

- Annual pension accrual of $800 per 1,000 hours worked in a calendar year;
- Normal retirement at age 65 but unreduced retirement is available at age 60;
- Normal form of pension is payable for life with 10-year guarantee;

[2] The task force does not believe that the use of a fixed discount rate is appropriate for a time horizon of 15 years and a broad range of economic outcomes. However, common practice is likely to be bracketed by these two approaches. Projection results on this basis are available on request.

- Pre-retirement death benefit is equal to the commuted value of the accrued pension subject to a two-year continuous service eligibility threshold;
- No plan member contributions are required;
- No increases in the annual pension accrual or cost of living benefits are provided; and
- Active members are credited with one year of continuous service for 1,725 hours of work in a year with pro-rata credit for years with hours worked less than 1,725.

Plan member data were grouped to reduce the volume of calculation in the projections. A summary of the data prior to grouping is outlined in table I.

Table I: Plan Member Data Summary

Summary of Member Data		
Date of Data:	31-Dec-2010	
Individual Records		
Active Data		
Count:	5,265	
Female:	820	
Male:	4,445	
Average Age:	44	
Average continuous service:	8	years
Average credited service:	6	years
Pensioner Data		
Count:	2,722	
Female:	374	
Male:	2,348	
Average Age:	69.5	
Average Lifetime pension amount:	$ 429.72	(per month)

The stochastic projections were based on a constant active plan membership of 5,265 members throughout the projection period. The demographic profile of the new entrants to the plan in the projection period is outlined in table II.

Table II: New Entrant Profile

Profiles	Male				Female		
Age Group	Proportion	Age	Hours worked per year		Proportion	Age	Hours worked per year
<25	14.5%	22.00	1725		3.5%	22.00	1725
[25-30)	11.9%	27.00	1725		1.8%	27.00	1725
[30-34)	8.9%	32.00	1725		1.4%	32.00	1725
[35-40)	8.7%	37.00	1725		1.7%	37.00	1725
[40-50)	23.1%	44.00	1725		6.5%	44.00	1725
>=50	14.1%	54.00	1725		3.9%	54.00	1725

Demographic Assumptions Used in Actuarial Valuations

The following demographic assumptions were used in the actuarial valuation at each year of the projection period:

- Mortality rates were extracted from the UP1994 table projected on a generational basis using Scale AA;
- No termination or disability rates were reflected; and
- Retirement rates were set to 66.67% at age 60 and 100% at age 65.

APPENDIX B – DETAILED TABULAR OUTPUT

Equity Allocation	20%
Bond Allocation	80% Long

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	8%	13%	18%	22%
	10%	13%	19%	25%	29%
25%	25%	7%	11%	17%	22%
	10%	12%	17%	24%	28%
50%	25%	5%	9%	14%	19%
	10%	10%	14%	21%	26%
75%	25%	4%	5%	9%	15%
	10%	8%	11%	16%	23%

Equity Allocation	40%
Bond Allocation	60% Long

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	8%	13%	16%	20%
	10%	17%	22%	26%	29%
25%	25%	7%	12%	15%	19%
	10%	16%	21%	26%	30%
50%	25%	6%	9%	12%	16%
	10%	15%	19%	24%	28%
75%	25%	5%	6%	7%	13%
	10%	13%	17%	20%	25%

Equity Allocation	60%
Bond Allocation	40% Long

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	9%	14%	16%	21%
	10%	21%	26%	30%	35%
25%	25%	8%	12%	15%	21%
	10%	20%	25%	30%	35%
50%	25%	8%	10%	12%	19%
	10%	20%	25%	27%	34%
75%	25%	7%	8%	9%	15%
	10%	19%	23%	27%	32%

Equity Allocation	80%
Bond Allocation	20% Long

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	11%	15%	17%	25%
	10%	25%	32%	35%	42%
25%	25%	10%	14%	15%	23%
	10%	25%	31%	34%	42%
50%	25%	10%	12%	13%	22%
	10%	25%	31%	33%	41%
75%	25%	9%	11%	12%	20%
	10%	25%	30%	36%	42%

Equity Allocation	20%
Bond Allocation	80% Universe

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	14%	21%	26%	33%
	10%	21%	29%	35%	41%
25%	25%	13%	19%	26%	33%
	10%	20%	27%	35%	41%
50%	25%	12%	18%	25%	33%
	10%	19%	25%	33%	41%
75%	25%	10%	15%	22%	31%
	10%	16%	22%	30%	40%

Equity Allocation	40%
Bond Allocation	60% Universe

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	13%	18%	23%	29%
	10%	22%	29%	34%	38%
25%	25%	12%	17%	23%	28%
	10%	21%	27%	33%	39%
50%	25%	11%	15%	19%	27%
	10%	20%	26%	31%	38%
75%	25%	9%	12%	16%	25%
	10%	19%	25%	30%	38%

Equity Allocation	60%
Bond Allocation	40% Universe

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	12%	17%	21%	27%
	10%	24%	30%	35%	40%
25%	25%	11%	16%	20%	27%
	10%	23%	30%	35%	40%
50%	25%	11%	14%	17%	26%
	10%	23%	29%	34%	40%
75%	25%	9%	11%	13%	23%
	10%	23%	28%	33%	41%

Equity Allocation	80%
Bond Allocation	20% Universe

		Required PfAD			
Retiree Liability Percentage	Percentile	Year 3	Year 5	Year 10	Year 15
0%	25%	12%	17%	19%	27%
	10%	27%	33%	37%	45%
25%	25%	11%	16%	19%	26%
	10%	27%	33%	37%	45%
50%	25%	10%	13%	16%	25%
	10%	27%	33%	37%	45%
75%	25%	10%	13%	15%	24%
	10%	27%	32%	40%	46%