SWOSS Appendix

1. Summary

This is the SWOSS Appendix to the Board's determination under Section 175(5) of the Act in respect of the 2020/21 Levy Year. Unless defined in this Appendix, expressions defined in the rules set out in the determination (the "Rules") shall have the same meanings as set out therein.

This Appendix applies to a SWOSS as defined in the Rules. It provides the formulae for calculating the RBL for such schemes.

Subject to any adjustments made pursuant to Rule C5 of the Rules, the RBL for a SWOSS is the higher of RBL_0 and POP, where:

a) RBL_0 is the RBL calculated as if the provisions of this Appendix did not apply (and, for the avoidance of doubt, also disregarding the provisions of the Commercial Consolidator Appendix), but based on:
- a single employer structure, with the employer placed in Levy Band 10;
- no application of the RBL cap;
- a mandatory requirement to Submit a bespoke stress analysis, irrespective of whether the scheme meets the Investment Stress Threshold; and
- no allowance for voluntary certifications.

For the avoidance of doubt, RBL_0 does not allow for any of the scheme-specific parameters set out in section 2 below or any adjustment to reflect understatement of risk for older valuation submissions set out in section 3 below.

b) POP is the value of a one year European put option calculated using the Garman-Kohlhagen formula, where:
- the strike price is the value of the scheme's protected liabilities on an adjusted basis, rolled forward or backward to the Output Date; and
- the spot price of the underlying asset is the market value of the scheme's assets, rolled forward or backward to the Output Date.

Because POP is assumed to be paid from the scheme's assets, it is technically an input to the put option formula as well as the output of that formula. This is allowed for by calculating POP using an iterative approach. The output of the nth iteration, POP_n, is deemed to reduce the scheme's assets used for input to the (n+1)th iteration, until the difference between $POP_{(n+1)}$ and POP_n has converged below a specified threshold.

2. Inputs

A SWOSS will be required to Submit to the Board such information as is specified in this Appendix and/or as the Board requires in order to calculate RBL_0 and POP in accordance with this Appendix. Such information must be Submitted in accordance with Rules A2.2(5) and A2.3(5) of the Rules and must be in a form and on terms acceptable to the Board. In the absence of one or more items of such information, the Board may exercise its discretion in relation to the calculation of the Levies pursuant to Rule C5.6 of the Rules.

Scheme-specific parameters

The scheme-specific parameters specified in the table below will apply where either:

(a) the Board has agreed to them in the Ongoing Governance Arrangement for a SWOSS; or

(b) they have been Submitted, together with such supporting evidence as the Board requires, by the Scheme trustees, and agreed in writing by the Board; or

(c) they are specified by the Board.

• Effective date of the asset and liability valuations required for output	OutputDate
• Factors to apply to liability valuations, to reflect scheme-specific assumptions in respect of:	
o pensions in payment	SSFacPen
o deferred members	SSFacDef
o active members	SSFacAct
o wind-up costs (excluding benefit installation/ payment)	SSFacWUExp
o benefit installation/payment expenses	SSFacPayExp

Liability data

The Section 179 Valuation results which have been Submitted for use in this calculation, rolled forward or backward to the Output Date without smoothing or stressing in accordance with the Transformation Appendix.[1] If the Output Date specified under this Appendix differs from the Output Date under the Transformation Appendix (31 March 2020), the Transformation

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[1] Paragraph 4.8 of the Transformation Appendix sets out the process for calculating smoothed but unstressed liability values. Unsmoothed, unstressed liability values are calculated by applying these provisions and also taking each Smoothed Yield (A(ii), B(ii), C(i), C(iii), D(i) or D(ii)) at the Output Date (as set out in paragraph 4.3 of the Transformation Appendix) to be equal to the corresponding unsmoothed yield.

Appendix should be applied as if the Output Date were the same as specified under this Appendix.

In addition, if the Submitted Section 179 Valuation results were prepared in accordance with version A9 (or any future version) of the Section 179 assumptions, the results are not converted to A8.[2]

• Liabilities in respect of pensions in payment	S179PL
• Liabilities in respect of deferred members	S179DL
• Liabilities in respect of active members	S179AL
• Estimated wind-up costs (excluding benefit installation/payment)	S179WUExp
• Estimated expenses of benefit installation/payment	S179PayExp
• External liabilities	S179ExLiab

The Section 179 Valuation results which have been Submitted for use in this calculation, rolled forward or backward to the Output Date with stressing but without smoothing in accordance with the Transformation Appendix[3]. If the Output Date specified under this Appendix differs from the Output Date under the Transformation Appendix (31 March 2020), the Transformation Appendix should be applied as if the Output Date were the same as specified under this Appendix.

In addition, if the Submitted Section 179 Valuation results were prepared in accordance with version A9 (or any future version) of the Section 179 assumptions, the results are not converted to A8.[2]

• Stressed liabilities in respect of pensions in payment	S179PLStressed
• Stressed liabilities in respect of deferred members	S179DLStressed
• Stressed liabilities in respect of active members	S179ALStressed

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[2] In these circumstances, the various assumptions underlying the annuity factors '@OutputDate' and '@S179Input Date' set out in paragraph 4.3.3 of the Transformation Appendix should be set to be consistent with version A9 (or such future version as applies) of the Section 179 assumptions guidance, together with the rollforward rates 'i' and 'j' set out in paragraph 4.4.1 of the Transformation Appendix.

[3] Stressed but unsmoothed liability values are calculated by applying the provisions of footnote 1 above and also applying the liability stress factors at the values shown in paragraph 4.2 of the Transformation Appendix, rather than zero.

Asset data

Scheme asset information Submitted for use in this calculation and rolled forward or backward to the Output Date without smoothing or stressing in accordance with the Transformation Appendix[4]. If the Output Date specified under this Appendix differs from the Output Date under the Transformation Appendix (31 March 2020), the Transformation Appendix should be applied as if the Output Date were the same as specified under this Appendix.

• Assets	S179Ass

Scheme asset information underlying the bespoke stress analysis Submitted for use in this calculation (asset amounts at the calculation date of the bespoke stress analysis, before applying the bespoke asset stress factors):

• UK quoted equities	AS1
• Overseas developed market quoted equities	AS2
• Emerging Market quoted equities	AS3
• Unquoted/private equity	AS4
• Property	AS5
• Hedge funds	AS6
• Commodities	AS7
• Fixed interest government bonds – short maturity	AS8
• Fixed interest government bonds – medium maturity	AS9
• Fixed interest government bonds – long maturity	AS10
• Inflation-linked bonds – short maturity	AS11
• Inflation-linked bonds – medium maturity	AS12
• Inflation-linked bonds – long maturity	AS13
• Fixed-interest non-government bonds – UK short and medium dated investment grade	AS14
• Fixed-interest non-government bonds – UK long-dated investment grade	AS15

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[4] Paragraph 4.8 of the Transformation Appendix sets out the process for calculating smoothed but unstressed asset values. Unsmoothed, unstressed asset values are calculated by applying these provisions and also disapplying the smoothing of index values set out in paragraph 4.4.3 where Date2 is specified as the Output Date.

• Fixed-interest non-government bonds – overseas short and medium dated investment grade	AS16
• Fixed-interest non-government bonds – overseas long-dated investment grade	AS17
• Fixed-interest non-government bonds – global sub-investment grade	AS18
• Cash and net current assets	AS19
• Annuities	AS20
• Insurance funds	AS21
• Other	AS22

Sensitivities of derivatives to interest rates and inflation rates underlying the bespoke stress analysis Submitted for use in this calculation (amounts at the calculation date of the bespoke stress analysis):

• Overall sensitivity of derivatives to a one basis point increase in interest rates	PV01
• Overall sensitivity of derivatives to a one basis point increase in inflation rates	IE01

3. Parameters

Factors to convert liabilities to the adjusted basis:

Factors to convert liabilities in respect of:		
• Pensions in payment	ConvFacPen	1.00
• Deferred pensioners and active members	ConvFacNonPen	0.88
• Estimated wind-up costs (excluding benefit installation/payment)	ConvFacWUExp	1.00
• Estimated expenses of benefit installation/payment	ConvFacPayExp	0.50
• External liabilities	ConvFacExLiab	1.00

Factors to reflect understatement of risk for older valuation submissions

Adjustment to total liabilities	LiabAdjFac	0% if the effective date of the Section 179 Valuation Submitted for use in this calculation is: • on or after 1 January 2018; and • at least one year after the effective date of the Section 179 Valuation Submitted for use in the calculation of the SWOSS' pension protection levies for the 2019/20 levy year, if the SWOSS was subject to the provisions of the SWOSS Appendix to the 2019/20 Levy Determination for that levy year. 5% in all other circumstances
Applicable time period	TimePeriod	The period from the effective date of the Section 179 Valuation Submitted for use in this calculation, to 31 March 2020, measured in years and complete months.

Stress factors

Risk factor stresses		
Interest rate risk factor stress	d_rates (basis points)	-75
Inflation risk factor stress	d_inf (basis points)	-14

Asset stress factors		Positive stresses (Str_i^+)	Negative stresses (Str_i^-)
UK quoted equities	Str1	0%	-19%
Overseas developed market quoted equities	Str2	0%	-16%
Emerging Market quoted equities	Str3	0%	-16%
Unquoted/private equity	Str4	0%	-19%
Property	Str5	0%	-5%
Hedge funds	Str6	0%	-3%

Commodities	Str7	0%	-14%
Fixed interest government bonds – short maturity	Str8	+2%	0%
Fixed interest government bonds – medium maturity	Str9	+6%	0%
Fixed interest government bonds – long maturity	Str10	+15%	0%
Inflation-linked bonds – short maturity	Str11	+1%	0%
Inflation-linked bonds – medium maturity	Str12	+5%	0%
Inflation-linked government bonds – long maturity	Str13	+18%	0%
Fixed-interest non-government bonds – UK short and medium dated investment grade	Str14	+4%	-2%
Fixed-interest non-government bonds – UK long-dated investment grade	Str15	+10%	-5%
Fixed-interest non-government bonds – overseas short and medium dated investment grade	Str16	+4%	-2%
Fixed-interest non-government bonds – overseas long-dated investment grade	Str17	+10%	-5%
Fixed-interest non-government bonds – global sub-investment grade	Str18	+2%	-8%
Cash and net current assets	Str19	0%	0%
Annuities	Str20	+16%	0%
Insurance funds	Str21	0%	-19%
Other	Str22	0%	-19%

Other parameters

Longevity volatility	LongVol	2.5%
Volatility adjustment	VolAdj	2.6%
Risk-free rate of return on assets	rA	Bank of England 12 month Overnight Index Swap (OIS) spot rate[5]
Risk-free rate of return on liabilities	rL	rA
Convergence threshold for successive iterations of POP	T	£1

4. Calculation of the standard Risk-Based Levy with adjustments (RBL_0)

RBL_0 is the RBL calculated in accordance with the provisions of the Rules (except Rules C5 and C6) and the Appendices (except this Appendix and the Commercial Consolidator Appendix), but using the information Submitted in accordance with Rules A2.2(5) and A2.3(5) of the Rules (or in accordance with any discretion exercised by the Board pursuant to Rule C5.6 of the Rules), and based on the following assumptions:

- The Scheme has a single Employer;
- The LR of the Employer is the LR of Levy Band 10 and, for the avoidance of doubt, that LR will not be treated as an Appealable Score;
- Rule C3.1 (the RBL cap) is dis-applied;
- The Scheme is required to Submit the information specified in the Investment Risk Appendix, irrespective of whether the Scheme meets the Investment Stress Threshold referred to in Rule D3 of the Rules; and
- Parts F, G and H of the Rules are dis-applied.

For the avoidance of doubt, RBL_0 does not allow for any of the scheme-specific parameters set out in section 2 above or any adjustment to reflect understatement of risk for older valuation submissions set out in section 3 above.

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[5] The Overnight Index Swap (OIS) spot rate to use for 2020/21 will be the figure as at 29 November 2019 and will be confirmed in the December Policy Statement. As an indication, the OIS spot rate used for 2019/20 was 0.79% as at 30 November 2018.

5. Calculation of aggregate stresses

5.1. Calculation of Asset and Liability Stresses (AS_+, AS_-, LbS)

Positive asset stress (AS_+)

AS_+ is obtained by applying all the positive stresses Str_i^+ (as shown in the third column of the asset stress factors table in section 3 above) to the corresponding assets of the scheme and then adding the impacts of the risk factor stresses on the derivative holdings.

$$AS_+ = \sum_{i=1}^{22} (AS_i \times Str_i^+) + (PV01 \times d\_rates) + (IE01 \times d\_inf)$$

AS_+ is expected to be positive other than for exceptional cases (for example with significant negative asset allocations within the summation).

Negative asset stress (AS_-)

AS_- is obtained by applying all the negative stresses Str_i^- (as shown in the fourth column of the asset stress factors table in section 3 above) to the absolute (or modulus) value of the corresponding assets of the scheme.

$$AS_- = \sum_{i=1}^{22} (|AS_i| \times Str_i^-)$$

By construction AS_- is a negative number.

Liability Stress (LbS)

LbS is obtained by applying the interest rate and inflation stresses to the liability value (excluding expenses and external liabilities) on an adjusted basis. It is calculated by taking the difference between the stressed and unstressed values after roll forward or backward to the Output Date and then adjusting this difference to reflect:

- the relevant conversion factors set out in section 3 above;
- any scheme-specific parameters from section 2 above; and
- any adjustment to reflect understatement of risk for older valuation submissions as set out in section 3 above.

$$\begin{aligned}
LiabAdj = [\, &S179PL \times ConvFacPen \times SSFacPen \\
&+ (S179DL \times SSFacDef + S179AL \times SSFacAct) \times ConvFacNonPen \\
&+ S179WUExp \times ConvFacWUExp \times SSFacWUExp \\
&+ S179PayExp \times ConvFacPayExp \times SSFacPayExp \\
&+ S179ExLiab \times ConvFacExLiab\,] \times (1 + LiabAdjFac)^{TimePeriod}
\end{aligned}$$

$$\begin{aligned}
LbS = \{\, &(S179PLStressed - S179PL) \times ConvFacPen \times SSFacPen \\
&+ [\, (S179DLStressed - S179DL) \times SSFacDef + (S179ALStressed - S179AL) \times SSFacAct\,] \\
&\times ConvFacNonPen \} \times (1 + LiabAdjFac)^{TimePeriod}
\end{aligned}$$

By construction LbS is a positive number.

5.2. Calculation of first level aggregate stress including risk due to over-hedging or under-hedging interest rates (X_1)

The first level aggregate stress is given by the formula:

$$X_1 = \sqrt{AS_-{}^2 + Max(0, AS_+ - LbS)^2} - Min(0, AS_+ - LbS)$$

This can be simplified by deconstructing the formula to differentiate between schemes which are over-hedged on the adjusted basis (liability stress smaller than the overall positive asset stress) and under-hedged on the adjusted basis (liability stress greater than the overall positive asset stress).

If $LbS < AS_+$:

$$X_1 = \sqrt{AS_-{}^2 + (AS_+ - LbS)^2}$$

Else:

$$X_1 = |AS_-| - AS_+ + LbS$$

5.3. Calculation of second level aggregate stress including longevity risk (X_2)

This calculation aggregates the effect of the investment risk factor stresses with a longevity shock ($LongShock$). It assumes that longevity risk and investment risk are independent.

$$LongShock = LongVol \times LiabAdj$$

$$X_2 = \sqrt{X_1{}^2 + LongShock^2}$$

6. Calculation of volatility estimate ($VolEst$)

$$VolEst = \frac{X_2}{S179Ass} + VolAdj$$

7. Calculation of the first iteration of the put option price (POP_1)

First calculate the volatility adjusted distances to the strike price (d_1 and d_2).

$$d_1 = \frac{ln\left(\frac{S179Ass}{LiabAdj}\right) + \left(rA - rL + VolEst^2/2\right)}{VolEst}$$

$$d_2 = d_1 - VolEst$$

The first iteration of the price of the put option (POP_1) is given by the formula:

$$POP_1 = LiabAdj \times e^{-rA} \times N(-d_2) - S179Ass \times e^{-rL} \times N(-d_1)$$

where:

"e" is Euler's number, a mathematical constant[6];

"$ln(x)$" denotes the natural logarithm of x, i.e. the power to which e would have to be raised to equal x;

$N(.)$ denotes the cumulative standard normal distribution function, given by the formula:

$$N(x) = \int_{-\infty}^{x} \frac{e^{-t^2/2} dt}{\sqrt{2\pi}} \text{ ; and}$$

"π" is a mathematical constant, the ratio of a circle's circumference to its diameter.[7]

8. Calculation of successive iterations of the put option price (POP_n)

The calculations in sections 5, 6 and 7 above are repeated to calculate successive iterations of the put option price. For all values of n greater than or equal to two but less than or equal to 100, the nth iteration, POP_n, is calculated as POP_{n-1} but with the input assets and spot price, $S179Ass_n$, taken as the corresponding figure from the first iteration, $S179Ass$, reduced by POP_{n-1}. For this purpose the assets are assumed to retain the same proportionate breakdown and the same values of PV01 and IE01 in each successive iteration.

$$\partial n = |POP_n - POP_{n-1}|$$

For all values of n from 2 to 99 inclusive:

If:
- $\partial n \leq T$; and
- $POP_n < S179Ass - SBL$

$POP = POP_n$

Else if $POP_n \geq S179Ass - SBL$

$POP = S179Ass - SBL$

Else proceed to the (n+1)th iteration.

If $POP_{100} < S179Ass - SBL$,
$POP = POP_{100}$
else
$POP = S179Ass - SBL$

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[6] For the purposes of information only, "e", to 10 decimal places is: 2.7182818285

[7] For the purposes of information only, "π", to 10 decimal places is: 3.1415926536

9. Calculation of the Risk-Based Levy (RBL)

Subject to any adjustments made pursuant to Rule C5 of the Rules, RBL for a Scheme without a substantive Employer is the greater of:

(a)   the standard risk-based levy calculated in accordance with the Rules (except Rules C5 and C6) and Appendices (except this Appendix and the Commercial Consolidator Appendix), but using the information Submitted in accordance with Rules A2.2(5) and A2.3(5) of the Rules (or in accordance with any discretion exercised by the Board pursuant to Rule C5.6 of the Rules), and based on the assumptions described in section 4 above; and

(b)   the put option price calculated in section 8 above.

$$RBL = Max(RBL_0, POP)$$