EXAMINERS' REPORT

June 2016 examinations

Subject F103 — *General Insurance*
Fellowship Principles

INTRODUCTION

The attached report has been prepared by the subject's Principle Examiner. General comments are provided on the performance of candidates on each question. The solutions provided are an indication of the points sought by the examiners, and should not be taken as model solutions.

QUESTION 1

i. Excess of loss reinsurance indemnifies the cedant for the amount of a loss above a stated excess point, usually up to an upper limit.
A working layer is a layer of excess of loss reinsurance where the excess point is at a low enough level for it to be likely to experience a fairly regular flow of claims.

Profit commission is the only type of reinsurance commission likely to be payable (if any).
This is commission which is dependent upon the profitability or claims experience of the business ceded during each accounting period.
Profit commission may be payable for a working layer because the experience in a working layer is less random than for higher layers and is more likely to be representative of the underlying risk.

ii. (a) Recovery = 0.25 × \$12m = \$3m

(b) Retention = \$50m (maximum)
Proportion to B (of what is left after A)
= (0.75 × 100m – 50m) / (0.75 × 100m) = 1/3
Hence recovery = 0.75 × 1/3 × 12m = \$3m

(c) Balance of claim after A&B = \$12m – \$3m – \$3m = \$6m
Hence recovery = \$4m.

(d) All 4 lines need to be used to keep the minimum retention
This results in a retention of 0.75 × 80 / 5 = \$12m, which exceeds the minimum limit of \$10m
Proportion to B (of what is left after A) = 5/6
Hence recovery = 0.75 × 5/6 × 40m = \$24m

(e) Balance of claim after A&B = \$40m – \$10m – \$24m = \$6m
Hence recovery = \$4m.

(f) Since the recovery from C is only \$1m we know that the balance of the claim after A&B cannot have exceeded the upper limit on the XL cover (\$7m).
Hence X is left (after recoveries from A, B & C) with \$2m.
Thus we have:
(f) = 0.25(f) + \$(6+1+2)m
0.75(f) = \$9m, and thus
(f) = \$12m.

(g) Retention = \$50m (maximum)
Let the Sum Insured be *S*. Then:
Proportion to B (of what is left after A)
= (0.75 × S – 50m)/(0.75 × *S*) = 6m/(0.75 × 12m) = 2/3
Hence *S* = \$200m

Part (i), which was straight bookwork, was extremely poorly answered by most candidates. Many candidates defined a working layer as the "first layer" of excess of loss cover. Saying the layer is the first layer does not imply that it is a working layer, as the first layer could still have a high excess point. Many candidates also made the obvious comment that the first layer will experience higher claims frequency than other layers, which again does not define what a working layer is. Many candidates suggested that return and override commission were appropriate for a working layer – this was penalised. Most candidates also claimed that profit commission was dependent on the reinsurer making profit, which it isn't.

Part (ii) was answered fairly well by the better prepared candidates. Answers were generally well explained. Some candidates thought that they needed to make reference to EML, which was not the case. A few candidates lost marks by neglecting to include the correct currency and units.

QUESTION 2

i. A stability clause is a clause that may be included in a non-proportional reinsurance treaty, providing for the indexation of monetary limits (that is, the excess point and/or the upper limit) in line with a specified index of inflation. It is designed to maintain the real monetary value of the excess point and the upper limit under non-proportional reinsurance.

   The impact of a stability clause depends on the cedant's actual claims experience and on the inflation in claims relative to the specified index and also the excess point and upper limit. If there was no upper limit and actual claims inflation was lower than the specified index inflation, then the frequency of losses to the layer would drop over time. If claims inflation is the same as that used on the specified index, then the expected real cost of claims will remain constant.

   A deductible is the amount which, in accordance with the terms of the policy, is deducted from the claim amount that would otherwise have been payable and will therefore be borne by the cedant.
   An aggregate deductible is the maximum amount that the cedant can retain within its deductible when all losses are aggregated.
   Ranking deductibles (applied to each individual loss) do contribute towards an insured's aggregate deductible. Non-ranking deductibles and trailing deductibles do not contribute to the aggregate deductible.

Introduction of an aggregate deductible means that the sum of the claims to the layer must exceed the deductible before the cedant can make a recovery. So, for a given amount of exposure, we expect the aggregate deductible to reduce the cedant's expected recovery and increase the cedant's retention.

A per-occurrence limit is the maximum amount that the insurer can retain for each individual loss.

Introduction of a per occurrence limit means there is a maximum potential loss on each claim and hence adding a per occurrence limit would reduce the expected cost of claims.

ii. Step 1: Determining the claim frequency and severity distributions

- Using the companies claim database, check data for completeness and correct any obvious data anomalies.
- Pick a base period to use e.g. the last 5 years.
- If there are any policy limits on the claims, an estimate of the number (and amount for each claim) needs to be estimated for those below the insured's retention and those above the policy limit.
- Use standard reserving techniques, e.g. chain ladder or Bornhuetter-Ferguson methods, to calculate the number of IBNR claims and their cost. For a frequency-severity approach, we need to know the individual claim sizes and period in which the claim occurred. It is important to apply a development pattern that is appropriate for the losses being developed.
- All claims from past years (including IBNR) need to be developed to ultimate and treated "as-if" they occurred in the following period. Consider appropriate assumptions to adjust for claims inflation, changes in policy wording / risks covered.
- A decision regarding large and catastrophe claims needs to be made. Large claims and catastrophe claims are normally modelled separately. If a large claim is removed from the severity analysis it should also be removed from the frequency analysis.
- Fit frequency and severity distributions to the losses, e.g.
  - Frequency: Poisson, Negative Binomial.
  - Severity: LogNormal, Weibull, Pareto, Gamma.
- Apply statistical tests to determine goodness of fit e.g. Chi-Squared Test or Kolmogorov-Smirnov Statistic.
- If there is a sufficient volume of losses, consider fitting a number of different severity distributions to different parts of the overall loss range.

Step 2: Determine exposures for the next three years

- Using the company's database with exposures, assumptions regarding for new business numbers over the next three years can be determined.

Step 3: Simulation for a specific reinsurance structure

- Simulate Claims experience in each year based on exposures for each year.

- Re-run simulation a number of times, e.g. 100 000. Each simulation will produce its own estimate of the number of claims and corresponding set of claim amounts.

- For each simulation, apply excesses, limits and deductibles to determine total reinsurance.
- The average reinsurance recovery over all simulations in a particular year plus a loading for catastrophe and large claims would give an estimate for the reinsurance risk premium.

Step 4: Repeat step 3 for different reinsurance structures

Part (i) was mainly bookwork, however many candidates failed to explain the effect that a "stability clause", "aggregate deductible" and "per-occurrence limit" would have on the expected cost of claims.

Part (ii) was a relatively easy question for candidates who knew the theory well and those who wrote an appropriate amount scored reasonably well. Those who did not score well generally made too few points or failed to outline simulating future claims and new business numbers over the next 3 years.

QUESTION 3

i. Until now the insurer has only collected aggregate data, so its own internal systems may not be able to administer the new data formats without substantial changes to its own infrastructure.

As each agent operates as an independent insurer, it means that the data and reporting system of each agent could be unique and hence could have unique definitions for:

- Policy and claim numbers and sequencing, especially if offering multiple sections of cover under the same policy.
- Relevant dates.
  - E.g. Inception dates (some insurer will define as first date of inception where others might be updating annually based on the latest renewal date).
  - Loss date – some insurers may record date of loss and others the date reported.
- Codes for claim types or perils e.g. catastrophe vs. earthquake/flood/wind
- Coverages provided, e.g. fire vs buildings

Some agents may only be capturing the summary information currently being sent to the insurer. Therefore they might not be able to send through the monthly data required.

Different agents may write very different classes of business and hence the volumes of data may vary substantially.

There may even be challenges in transferring large files securely from the agent's system to the insurer system (security is a major consideration for personal data).

Some agents would only keep track of the latest financial position of the policy or claim where others may be collecting all the transactional data. The insurer would need to take care that this is interpreted correctly or there may be duplication in data from one month to the next.

ii. For reserving purposes, the insurer would need to build up a history of movements of paid and incurred amounts in order to project the future IBNR.

Where transactional data is provided, the paid amounts will constitute the actual payments made on account during the month and a paid triangle can be constructed by accumulating payments by accident month cohorts over each development month. Usually, the outstanding case reserves will be provided as movements over the period, and then the same process can be followed by aggregating movements over accident and development periods and adding to the paid triangle in order to obtain an incurred triangle.

Where the data is provided as latest monthly positions, the insurer will have to keep track of movements on each claim from month to month. This can be done by creating a new version of a claim position each time there is a change in any of the details or financial amounts. To construct a triangle, the insurer will calculate the movements in paid and outstanding amounts across all claims by accident and development month.

For both types of data, claim numbers reported triangles can be constructed by considering the difference between the occurrence and notification dates per claim.

iii. Potential challenges:

- The agents may use different definitions of when a claim is first recorded, e.g. when first notified or when all supporting evidence has been provided.
- One agent may remove claims from its monthly listing if it settles as null, where the other may keep the claim on the listing with a zero amount.
- The agents may have different approaches to setting case reserves, e.g. one might put a conservative/full reserve on notification, whereas the other may put a token or zero reserve until investigations have been completed.
- They will have different processes for settling a claim, so the speed of paid settlement will vary between agents.
- Whilst both agents write the same class of business, they may operate in different geographical locations and sell to different target markets.
- Each agent may use different sales channels resulting in a different mix of underlying risk with different development patterns.

Part (i) was relatively easy, with the better prepared candidates scoring well. The most common mistake was not providing enough detail (the question says 'describe' not 'list').

Part (ii) was not well answered. Candidates often failed to understand what the question asked and did not describe what each insurer would need to do to their data to ensure that it was in the appropriate format (i.e. having claim amounts and numbers aggregated over development and accident periods so that one could create a run-off triangle).

Part (iii) was generally well answered.

QUESTION 4

i. A stochastic model is better for considering a bigger set of possible scenarios (usually several thousand) while a deterministic ALM can only practically consider a few scenarios.

The scenarios in the stochastic model are chosen randomly and therefore not subject to the modeller's potential biases and limited perspective.

A stochastic model's outputs incorporate probabilities (thus the likelihood of unfavourable outcomes associated with particular investment strategies), while the output from a deterministic model does not.

Both stochastic and deterministic ALMs can allow for suitable interaction between assets and liabilities, so this in itself is not a difference.

Risk-based solvency regimes like SAM and Solvency II require a better understanding of risks (including investment risks) faced by the company, which are better modelled by a stochastic ALM.

Stochastic models may have higher model risk (due to greater complexity) and introduce spurious accuracy in the modelling.

Practical difficulties are greater for stochastic models:

- Stochastic models are more difficult (requiring expertise) to build, calibrate and run.
- They require more data than deterministic models.
- More costly to obtain (build or purchase) and to maintain.
- The output may be more difficult to interpret.
- More time consuming to run.

ii. An ESG typically takes the form of a specialised asset model that stochastically models various asset classes.

The output from an ESG includes the performance of each economic variable (e.g. inflation, asset class returns, GDP etc.) at each future projection point for several simulations.

This table of simulation outputs will be used as an input for the ALM.

iii. The investment characteristics of employers' liability liabilities:

- Liabilities are inflation-linked (and expected to increase faster than CPI as they are related to loss of earnings, medical costs and judicial inflation, all of which are expected to increase faster than CPI).
- Long term (for serious disability and death claims) and short to medium term (for more common injury and property damage claims). Overall liabilities should be considered long term as the largest claim liabilities would tend to be longer tailed.
- Quite possibly multi-currency, with many large employers now operating in various geographies.
- Considerable uncertainty of ultimate settled claim amounts and timing.

The above liability characteristics imply that a matched investment position would comprise:

- Equities: returns are expected to be higher than CPI inflation over long terms, thus matching the nature and term of liabilities.
- Index-linked bonds of suitable term: provide CPI-linked returns, thus provide a partial match for expenses and liabilities (particularly shorter term liabilities).
- Conventional bonds: these might be suitable for shorter/medium term liabilities: actual inflation is unlikely to be far different from expected inflation over shorter terms.
- Cash might be suitable for shorter term liabilities: provides liquidity (suitable for liability uncertainty) and returns are broadly in line with CPI.

iv. In respect of existing business, the term will shorten considerably (to a few weeks or months, depending on how soon the liabilities can be transferred). Even though liabilities remain inflation-linked over this period, the insurer's primary concern will be liquidity and stable asset values to pay the required premium.

For future new business, the liability profile is shortened to a few years (until the RITC premium is paid). The Liability profile for new business will be inflation-linked and short-term. The implications for the matched position for these liabilities are:

- Equities are unlikely to be suitable, due to volatile prices in the short term.
- Index-linked bonds are sensitive to changes in real interest rates, so these assets may also be too volatile.
- Conventional bonds (maturing within a few years) are likely to be most suitable: actual inflation is unlikely to be far different from expected inflation over shorter terms, and they provide good liquidity.
- Cash might be suitable: provides liquidity and returns are broadly in line with CPI.

It may be possible for the reinsurer to accept suitable matching assets instead of cash as the RITC premium, however the reinsurer will have its own its investment considerations and will probably wish to invest the assets differently from the syndicate.

While overall performance was reasonable, it varied considerably by candidate, and by question part.

Part (i) was done very well by most candidates. Part (ii) was generally also done well, however a few candidates provided very little detail regarding the output of an ESG.

Part (iii) was done well by some candidates. A number of candidates provided much detail about the features of the liabilities, without linking these to suitable matching assets. A number of candidates wrote about the influence of free reserves and mismatching, which was completely irrelevant for the question asked. Too many candidates suggested that long-term fixed interest bonds are suitable for inflation-linked liabilities.

Part (iv) was not done well, with several candidates making no or a weak attempt (presumably due to mismanagement of time), and many candidates not writing about matching investments but about irrelevant topics. Again a number of candidates wasted time writing about free assets and mismatching.

QUESTION 5

i. The following areas should be considered when deciding on the suitability of the development factors.

Trends in development factors:

- Both the incurred and paid development factors show clear down trends across accident years.
- These trends may invalidate the BCL assumption that accident years follow the same distribution.
- The reasons for the trends should be understood. This may be due to the change in business mix in which case separate claims triangles for personal and corporate may resolve this issue.
- Should trends still be apparent after considering personal lines and corporate business separately then expert judgement may be needed to select development factors. It could even be questioned whether the BCL is appropriate and if other methods e.g. Loss Ratio methods may be more suitable.
- The decreasing trend in the 1-2 development factors may indicate that the claims settlement delay has been reducing over time.

Reconciliation differences:

- Large unexplained data reconciliation differences may well imply that the data are not appropriate to use in BCL projections. This could lead to a material understatement or overstatement of IBNR reserves.
- The BCL requires that all underlying claims data are reconciled to an independent source e.g. the financial accounts before being applied.

Business mix:

- The change in business mix between personal lines and corporate business is likely to lead to heterogeneous data, and thus invalidate the assumption of homogenous data underlying the BCL method. It is advisable to use separate claims triangles for corporate and personal lines, credibility allowing.

Sufficiency/credibility of data:

- The data may not be sufficient or credible enough to derive paid and incurred development factors. This is evident since the development factors show that the data are not completely run-off i.e. the 2011 accident year 4 – 5 development factor is 1.04 and 1.19 for incurred and paid claims data respectively.
  This may lead to an understatement of the IBNR. A tail factor can be fitted to address this issue.
- It is likely that 4 years of historical data is not sufficient to derive development factors. This is especially the case for personal lines which has only recently increased in volume and thus has little historical data available.

Large claims:

- Large or catastrophic claims in the paid or incurred triangles may distort the development factors for attritional claims. This is especially the case for the R20m case estimate in the 2015 accident year which will need to be considered separately.
- Large and catastrophic claims may need to be removed from the claims triangles and reserves for large and catastrophic claims calculated separately.

Case estimation clean up:

- The case estimation clean-up will affect the latest diagonal only. Depending on the extent of margins that are released it may mean that the last diagonal is not suitable to use in the estimation of development factors. It may be necessary to exclude the last diagonal from the selection of development factors or to use expert judgement to adjust these development factors.
- Using the incurred claims development factors without any adjustments for the case estimation clean-up will likely result in an underestimation of the IBNR.

Other:

- The difference in IBNR estimated using paid versus incurred claims data could be substantial. A reason could be due to the long term nature of liability business, implying that incurred claims data are expected to be a lot more developed than paid claims data, especially for the more recent accident years. Using incurred claims data for the more recent accident years is likely to provide a better estimate of IBNR after adjusting for any data anomalies e.g. large claims.
- Large and catastrophic claims may not be adequately captured in the data. Include an additional loading for large and catastrophic claims to cater for this.
- The suitability of the data depends on the stability of incurred or paid claims development patterns. Curve-fitting techniques could be used to smooth the development.
- Case estimates for liability claims may be difficult to estimate and thus may be subject to change which may distort the incurred claims development patterns. Using paid claims data or other reserving methods e.g. loss ratio or BF method may address this.
- The incurred development factors appear more stable than the paid development factors.
- Consider whether claims handling expenses are included in the claims data. If these are included then no adjustment is necessary, otherwise a separate adjustment for claims handling expenses is needed.
- Consider whether claims data are net of salvages, third party recoveries and reinsurance recoveries. If these are included then no adjustment is necessary, otherwise a separate adjustment is needed.
- There are potential outliers e.g. in accident year 2011 for development factors 3 - 4 and 1 - 2 which may distort the IBNR. Subjective judgement could be used to adjust or remove any excessively high or low development factors.
- Claims inflation implicitly assumed in the development factors may not be appropriate. The use of the inflation-adjusted chain ladder method may cater for this.

ii. Calculation of IBNR with selected methodology:

(Amounts in R'000s)

Accident Year	*Selected approach*	*Earned Premium*	*Ultimate Claims*	*Incurred Claims*	*IBNR*
2011	BCL Incurred	182,591	159,400	151,810	7,590
2012	BCL Incurred	187,155	160,059	146,843	13,216
2013	BCL Incurred	196,513	163,247	136,039	27,208
2014	BF Incurred	206,339	133,068	87,611	45,458
2015	Loss Ratio	216,656	119,161	60,252	58,908
Total IBNR at 31 December 2015					152,380

iii. Calculation of discounted mean term for the 2015 accident year and comments on the effect of discounting for this accident year:

Accident Year 2015	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**Total**
Duration : t	0	0.5	1.5	2.5	3.5	4.5	0
% of Total Ultimate paid	13%	19%	22%	23%	14%	9%	100%
% of Claims Reserves paid		21%	26%	26%	16%	10%	100%
Projected payments : P_t		21 980	26 311	26 642	16 926	10 743	102 601
Discount factor : V^t		0.98	0.94	0.91	0.87	0.84	
$V^t \times P_t$		21 553	24 808	24 153	14 755	9 004	94 274
$t \times V^t$		10 777	37 212	60 383	51 642	40 520	200 533

Accident Year 2015	(R 000)
IBNR	61 815
OCR	40 786
Total undiscounted	102 601
(1) : $\sum (V^t \times P_t)$	94 274
(2) : $\sum (t \times V^t)$	200 533
Discounted Mean Term (2)/(1)	2.13 years

Discounting by 4% p.a. reduces the claims reserves by R8 327 492 (8.1%) for the 2015 accident year.

Parts (i) and (ii) were reasonably well answered by the better prepared candidates. However, in part (i) a number of candidates did not answer the question and gave generic answers which did not relate to the question. For example some candidates gave a general overview of the chain ladder method without discussing the suitability of the actual data given in the question for use in the chain ladder projection. In order to score well candidates needed to consider the additional information given in the question and relate this to the suitability of the incurred and paid claims development factors.

In part (ii) the correct approach was to use the earned premium in the calculation of the ultimate claims for the 2015 accident year. However, marks were given if the written premium was used. Marks were awarded for stating assumptions, e.g. that premiums are assumed to be earned uniformly over the year. Some candidates deducted paid claims from their calculated ultimate claims. This resulted in the calculation of a claims reserve i.e. IBNR plus Outstanding Reported Claims reserve while the question asked for the calculation of an IBNR reserve. Some candidates assumed that the development factors given where incremental development factors and converted these to cumulative development factors. The question clearly stated that the development factors were cumulative. Some candidates did not know how to apply the Basic Chain Ladder method to calculate an IBNR, and many did not know how to use the Bornhuetter-Ferguson method.

Part (iii) was challenging, and required an understanding of how to estimate a paid run-off pattern given Chain Ladder development factors. This part was very poorly answered, with many candidates not even attempting to answer it.

QUESTION 6

i. Regulatory capital - the amount of capital an insurer is required to hold for regulatory purposes, also known as solvency capital.

   Economic capital - the amount of capital that a provider determines is appropriate to hold given its assets, its liabilities, and its business objectives.

ii. Economic capital is typically calculated using an insurer's own internal model, whilst regulatory capital would usually be calculated using a prescribed model or formula.

   Economic capital would use a detailed breakdown of assets and risk exposures, using an insurer's own risk profile, whereas regulatory capital would use data which are summarised to a degree, and applying market risk profiles/characteristics.

   The economic capital requirement may be on a more realistic basis, without any prudence which may exist on a regulatory basis. Even a regulatory basis which is on a best estimate basis may include a risk margin which represents an adjustment for uncertainty.

   Economic capital may use a higher level of confidence than the regulatory figure, especially if this is a published risk disclosure (or is used to achieve a higher credit rating).

   Risks and events may be correlated in a very complex manner in an economic capital setting, whilst this is normally more simply applied in a regulatory setting.

iii. An insurer would reduce the risk that the available capital falls below the regulatory requirement, which would hamper the firm's business activities. For example, an insurer who held only marginally more capital than the regulatory minimum would be exposed to the risk that a fall in asset values or a large claim would result in it being declared insolvent on a regulatory basis.

   A greater degree of security is achieved by policyholders than implied by the relatively weak regulatory minimum. This may not be as important as the investor's perceptions of security.

   A firm with a higher degree of solvency will be more able to maintain its credit rating. Credit rating models will be different from regulatory models and as such firms will be less certain of maintaining a certain credit rating than simply remaining solvent.

   To meet the requirements of other stakeholders such as debt providers, whose interests may be subordinated to those of the policyholders. The regulator would not require regulatory liabilities to include amounts owed to subordinated debt holders because this will not affect the ability of the insurer to pay policyholders (as they are paid before sub-ordinated parties). Nevertheless, the insurer will want to meet all of its liabilities.

To maintain a level of working capital for investment in business development and other opportunities. This needs to be balanced with holding too much capital which shareholders may not accept.

An insurance company which is capital flush can afford to allow for a buffer between the actual profitability of the business and the dividend stream paid to shareholders, who prefer less volatile returns.

iv. The overarching principle is that the adjustments to the business plan should serve to make the parameters of the model as realistic as possible, in order for the bias in the assumptions made to be removed.

The position in the underwriting cycle should be considered as this may cause assumptions to be inadequate given the current economic conditions which cannot be expected to change significantly over one year.

This may affect both the adequacy of premiums as well as claims ratios.

Premium adequacy can be adjusted through the use of an historical rate index, whilst claims ratios can be adjusted through the use of credibility techniques.

Past business plan accuracy may be considered as a way to justify any departure from business plan assumptions, in order to explain the difference between the best estimate model result and the business plan result.

The volume of business will need to be adjusted to reflect the most likely growth expected given past experience.

Allowances will have to be made in the business plan for large and catastrophic losses, which may not be allowed for in the business plan.

Expense splits between direct and indirect expenses may need to be introduced into the internal model in order to correctly allow for the impact of new business on direct expenses, where these are not allowed for in the business plan. Commission should already be split out.

Expense reductions should be allowed for where these savings have been adequately explained and justified.

Part (i) was bookwork, and was generally well answered.

Part (ii) was also generally well answered, although not enough distinction was made between regulatory and economic capital for the marks available. The question specifically asked about how calculations may differ, which was not always addressed by candidates.

Part (iii) was bookwork, and was generally well answered by most candidates.

Part (iv) was poorly answered. Little reference was made to what may be available from the business plan and how these figures may be adjusted for use in the capital model. Typically candidates answered in relation to standard capital model parameterisation.

QUESTION 7

i. All of the existing large policies are likely to be provided through brokers, thus it would be unwise to disturb existing business. If anything, only new policies should be pushed through the direct channel. Though, this should probably not be forced as it may result in the company losing new business that is presented to the company by brokers, as they will simply move to a competitor rather than proceeding to work through the direct sales method.

   Even if the move is only for new business, when existing brokers hear about the move they may feel unfairly treated and decide to take their existing business elsewhere, resulting in a large loss of business for the company, particularly as these are the larger policies. This could result in a reputational risk.

   The larger unusual products will likely require a fair level of expertise from the brokers. Alternatively, the insurer can train its own staff, though this will be costly and less flexible. Flexibility is important as the company regularly takes on different types of business.

   The direct sales method will be mostly fixed cost, though potentially with a small commission component, while brokers are paid purely by commission. Broker commission can be substantial on larger policies as it is usually expressed as a percentage. It is thus possible that the direct sales unit can be run at a lower cost. Furthermore, as the direct marketing channel is already established for personal lines business, an expansion of the unit should be less expensive than establishing a unit from scratch.

   Brokers act in the interest of policyholders and are inclined to shop around for the best deal. While direct sales units act on behalf of the insurer. Thus, the broker method is likely to be more competitive, potentially resulting in premiums needing to be lower and hence lower profit.

   However, on the flip side, brokers may present more business to the company as brokers are generally more proactive in seeking business due to the commission incentive. With unusual products, the markets may not be all that structured, making an effective direct marketing campaign tricky. It may be safer to rely on brokers to search for business.

   An important consideration is how profitable the broker business has been. If it has been less profitable then it may be worth the risk of implementing the change as there is less to lose if they end up losing market share or something else goes wrong.

ii. Largest perils:

- By-products of the nuclear reaction may cause harm to employees and individuals in the communities surrounding the nuclear plant if not adequately contained. This could potentially result in a number of medical claims and law suits against the government from affected individuals.
- There may be some sort of explosion, resulting in damage to property and people's lives in the surrounding community.

iii. Given the lack of data it is likely that the estimated premium will be inaccurate, with the main risk being that the premium will be too low. The company may need to incorporate a high contingency margin due to this. This would make the product less attractive and the insurer may lose out on acquiring the business.

The availability and cost of reinsurance will play a role. There is the potential for very large liability claims, which the insurer may only be willing to take on if appropriate reinsurance can be put in place.

Capital requirements should be considered. The insurer will consider how the business fits into its larger portfolio. Is it sufficiently independent to provide a capital diversification benefit? If so, the business may result in higher expected profit per unit of capital for the business as a whole, even though this class may itself be seen as risky/uncertain.

Other options for the use of capital will be considered. Even if there is a diversification benefit, the insurer will consider other competing uses of capital. There may be other lucrative projects that are less risky.

The potential for future new business will be considered. Establishing a relationship with this country, may lead to future new business for the insurer, which is particularly desirable as the country is politically stable. Even if the business is high risk, or not particularly profitable in its own right, it may nevertheless lead to knock-on benefits.

Alternatively, the insurer may not wish to enable/facilitate a project that could potentially be very risky for society, and thus may choose not to insure it. This depends on the insurer's views on the safety of nuclear energy.

As this is a liability class, the extent of claims will depend on the legal environment, including the generosity of court awards and the culture to claiming (e.g. more likely to be sued in the US). The extent of potential court awards and uncertainty will either deter the company from offering the product or may result in it deciding to charge a higher premium.

Similarly, the countries insurance regulations will make a difference e.g. if capital requirements are very high the insurer will be less able to make a return on equity and hence less likely to sell the insurance.

iv. An explosion is likely to be a low-frequency, high-severity event, so modelling techniques can be drawn from those used for modelling catastrophes.

The company may be able to use proprietary software as a starting point, though such models are generally used for natural catastrophes such as earthquakes and windstorms.

It is important to get data on nuclear plant explosions worldwide to help with the parameterisation of the model. Nuclear power plants are not all that common, and explosions less common, so data will be scarce. Though, any data will be a useful starting point.

With data likely to be scarce, it is important to work with experts in nuclear energy to understand the key risks that may lead to explosion. Each of these components can then be modelled in more detail, being careful not to be spuriously accurate.

It is probably best to split frequency and severity, either by:

- parameterising a frequency distribution to generate number of explosions in a year (e.g. Poisson distribution) and a severity distribution for each explosion (magnitude, comparable to Richter scale for earthquake);
- generating a number of possible severity scenarios and attaching reasonable likelihoods to them.

It is important that the actual calculation of loss takes into account both the magnitude of the explosion and the density and nature of property and extent of human life in the area around the nuclear plant, with certain explosions reaching further away from the plant itself as this will affect the potential liability claims. This is particularly significant as the plant is in an urban area.

It probably makes sense to model bodily injury and property damage separately as the harm caused by by-products of reactions (causing medical liability claims) is likely to stretch much further away from the power station than the fire itself itself (resulting in property damage and medical liability claims).

The parameters and possibly modelling approach will need to be reviewed frequently to take account of new experience and research into the safety of nuclear power plants, particularly as this is a state of the art initiative.

In part (i) most candidates did not have trouble generating ideas, but a common mistake was to not discuss the considerations, which involved a balanced comparison between brokers and direct sales. Many candidates simply listed points.

In part (ii) most candidates identified two valid perils. Some candidates made the mistake of referring to property damage of the plant itself, rather than liability claims.

In part (iii) most candidates identified six considerations, but many simply listed the consideration without outlining why it was important. Several candidates focussed too much

on factors that would affect the price, ignoring the decision of whether to offer the product or not. The better candidates worked the details of the scenario into their answers.

In part (iv) the better candidates realised the similarity of losses to catastrophe losses and hence the applicability of catastrophe modelling techniques. The poorer candidates merely listed general steps in a model, without tailoring their answers to the insurer in question.

END OF EXAMINERS' REPORT