COUNCIL

138th Meeting
Warsaw, 7 and 8 June 2016

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First Light of the E-ELT

Council is invited to approve the Resolution contained in Annex 3 of this document.
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1 Introduction

In December 2014 Council approved the adoption of the two-phase approach for the construction of the E-ELT, described in doc. ESO/Cou-1553 rev 3 conf. dated 08.12.2014, and authorised spending on Phase 1 by means of a Resolution which is attached as Annex 1 to this document.

Phase 1 is for the 39m E-ELT with the instruments MICADO, HARMONI and METIS and the adaptive optics module MAORY, and is affordable without Brazil as a Member State. Phase 2, which is not yet approved, includes the LTAO module, additional segments for M1 and a second pre-focal station, and will complete the baseline E-ELT. The cost of E-ELT operations including the construction of additional instruments is secured in the long-term ESO budget.

First light of the Phase 1 E-ELT was to be no later than 2026. In this scenario no long-term loans were needed (based on December 2014 economic conditions). The Council Resolution requested that ESO be in a position to return to the baseline schedule originally foreseen with first light in 2024 if Brazilian ratification would be completed by early 2017.

The Cost-to-Completion (CtC) of the E-ELT set by Council is as follows (in 2016 prices):

- The Phase 1 CtC is 1048 MEUR if first light is in 2026 including 93 MEUR contingency and 133 MEUR for FTE costs;
- If first light is in 2024 then the Phase 1 CtC is lowered by 15 MEUR to 1033 MEUR, the overall costs being reduced by 9 MEUR for FTEs and 6 MEUR for additional maintenance and anti-obsolescence actions, and
- The Phase 2 CtC is 110 MEUR.

2 Overall status of Phase 1

All the technical work is on track for first light in 2024, consistent with Point 4 of the Council Resolution of December 2014 (Annex 1). The new road to Armazones and the platform for the telescope have been completed. Contracts for the shell and the support unit of the adaptive M4 mirror are running. Agreements are in place with all consortia building the Phase 1 instruments MICADO, HARMONI, METIS as well as the adaptive optics module MAORY, and development has started. This commits ESO funding for the hardware and also secures much additional expenditure for staff effort in the Member State institutions involved. Furthermore, a huge amount of work was done in preparation for the contracting of the opto-mechanics, not only to allow the placement of contracts in the timescale needed to retain first light in 2024 but also to identify cost savings.
The carefully designed multi-year procurement process to place a contract for the Dome and Main Structure (DMS) has been completed and the contract was awarded in an extraordinary Finance Committee meeting on 3 February 2016, with very broad support from the Member States. This brings the total commitment for Phase 1 contracts to approximately 65% of the materials budget of the Phase 1 E-ELT. 44% of the contingency has also been committed. The overall contingency situation remains healthy providing the opto-mechanics contracts are placed on the baseline schedule (first light in 2024).

3 The Opportunity

ESO is now in a unique position to implement the spirit of the 2004 Council Resolution on Scientific Strategy (doc. ESO/Cou-991 rev dated 07.12.2004), attached as Annex 2, and retain astronomical leadership and excellence into the era of extremely large telescopes.

The possibility exists to have a significant overlap with the James Webb Space Telescope (JWST; launch date 2018); to lead the follow-up of interesting targets found by the Large Synoptic Survey Telescope (LSST, first light 2023), and crucially to have first light before the Giant Magellanic Telescope (GMT) on Las Campanas in Chile and the Thirty Meter Telescope (TMT) planned for Mauna Kea in Hawaii. Both competing ELT projects have significant funding challenges and, in addition, TMT is stalled because of strong Hawaiian opposition (although it should be noted that both have a procurement model that is faster than ESO’s).

Realising the opportunity to be first requires staying on track for first light in 2024. This will also reduce costs and secure the CtC. In addition to the overall cost reduction of 15 MEUR described above, the cost of the opto-mechanics (which dominate the budget remaining after the DMS award) is under control if the contracts are placed forthwith.

4 The Challenge

Staying on track for first light in 2024 creates a potential cash-flow challenge. Since the Council approval of Phase 1 in December 2014, there has been an increased pressure on the cash flow due to the unexpected January 2015 drop in the value of the Euro which amounts to approximately 50 MEUR over the construction period. In addition, the payment profile of the DMS contract required bringing forward the use of 36.1 MEUR from the contingency. The current plan also assumes continuation of APEX for the period 2018-2022 and of La Silla operations beyond 2020 with the arrival of two new instruments (NIRPS and SOXS). Although the Brazilian Parliament has approved the Accession Agreement to ESO in May 2015, the ratification procedure has not yet been completed because the Brazilian President has not yet provided the final signature. This risk on the cash flow needs to be mitigated.
4.1 First Light in 2026

Figure 1 shows the income and expenditure without Brazil as a Member State, and with the placement of the remaining contracts for the E-ELT Phase 1 artificially stretched to lead to first light in 2026. This diagram shows the entire ESO programme over the E-ELT Phase 1 construction period and uses the financial assumptions as detailed in Section 7 below. It can be considered as an updated version of Figure 7 in doc. ESO/Cou-1553 rev 3 conf.

Annex 4 contains a list of the 35 contracts for the Phase 1 E-ELT with a value above 0.5 MEUR that all have been artificially delayed by two years. Most of these are in the opto-mechanics area, which compromise the bulk of the remaining expenditure. The contract award for M2 polishing was approved by Finance Committee during its meeting on 3 and 4 May 2016.

Significant costs have been absorbed by the Organisation during the period 2009 to 2025, including the cost of the delta Phase B study for the E-ELT and the cost of the HQ extension as well as the impact of social security increases and unfavourable exchange rate variations. Actions are underway to further lower costs and exposure to other currencies, including securing the EUR/CLP exchange rate for operations costs and for some contracts.

With the Euro-based pension scheme for new international staff member (ISM) contracts in place since 1 January 2014, and with all the ISM pensions now using a CHF exchange rate averaged over a shorter period than previously to calculate the staff members’ contribution, the dependency on the CHF is slowly decreasing. Figure 2 shows the cumulative savings predicted as a result of the Euro-based pension scheme.
Figure 2: Projected cumulative savings due to the Euro-based pension scheme. The solid colour shows the evolution of the number of staff on the CHF scheme (blue) and the new Euro scheme (teal). The broken blue line indicates the savings due to the change in the calculation of the average exchange rate (see text), and the solid green line shows the cumulative savings also taking into account the euro based pension scheme.

The progressive retirement plan approved by Council in December 2015 already has its first ‘takers’ which will further reduce the CHF exposure.

ESO has proposed to change the JAO on-site budget for ALMA to CLP in future rather than in USD. This will significantly reduce the risk on the EUR/USD exchange rate. This change has been approved by the ALMA Board on 7 April 2016 and will be used for the 2017 budget.

The cost of power to the observatories is being lowered by the construction of a solar plant on La Silla and by the grid connection to Paranal, which will be completed in mid-2017.

Finally, the efficiency of the Organisation has been improved through the matrixing of engineering staff.
4.2 Extra costs for First Light in 2026

Although first light in 2026 is allowed by the Council Resolution (Annex 1), it comes with very significant disadvantages:

1. Deliberately stretching a construction project increases its costs. Not only is there the 15 MEUR extra in FTE, maintenance and obsolescence costs, plus a similar amount or more borne directly by the Member States for the instrument teams, but in addition, there would be price increases on offers already provided by industry; for example, the DMS would have cost 5.5% more per year if extended artificially. On top of this, there is also the uncertain impact of indexation;

2. There are also reputational issues to consider: pausing running Calls for tender (CfTs), which by virtue of the Council Resolution (Annex 1) had to be compatible with 2024 first light, will damage ESO’s credibility with industry, especially after committing approximately 65% of the budget for Phase 1 contracts. This, coupled with the fact that ESO has a very advantageous credit line available from the European Investment Bank (EIB), would seriously damage ESO’s reputation, and

3. Last but by no means least is the potential tremendous loss of scientific impact: Building in a delay of first light to 2026 risks losing the scientific lead in the ELT era, including overlap with JWST and LSST, and falling behind GMT and/or TMT.

4.3 The EMAC Perspective

The E-ELT Management Advisory Committee (EMAC) report to Council in December 2015 strongly advises to continue to aim for first light in 2024. This advice is based on a full understanding of the global context, and on the significant achievement by the E-ELT team on the main procurements which ensure predictable costs if first light is maintained for 2024. The EMAC realized that, in case Brazil takes much longer to ratify the Accession Agreement, this may require dealing with significant but temporary cash flow challenges, which may require temporary borrowing.

4.4 Council Resolution on Scientific Strategy

First light in 2024 is fully in line with Council’s Resolution on Scientific Strategy of 2004 (Annex 2), which states that ESO’s highest priority strategic goal is the retention of astronomical leadership and excellence in the ELT era, and specifically to:

- Assure completion of ALMA, and efficiently exploit its superb scientific capabilities;
- Maintain the VLT in a world-leading position by effective operations support and continued upgrades;
- Exploit the unique capabilities of the VLTI;
• Construct an ELT on a competitive timescale, and
• Continue an effective partnership with the community and seek effective intercontinental collaborations for developing of future technologies and facilities.

4.5 Precedent for cash-flow shortfall

As pointed out by EMAC, projects require funding profiles that are typically bell-shaped curves, with a peak of spending in the middle. Dealing with such funding profiles when the Organisation has a flat income profile is a challenge. Indeed, the planning for 1996-2003 showed a negative cash flow from 1997 to 2002 during the construction of the VLT.

In 1995, following a recommendation by Finance Committee, Council approved a ‘line of credit’ of MDM 63 (1996 prices) for the VLT. The stated majority requested was ‘two-thirds’ and the final vote was six in favour, one against (FR) and one abstention (DK).

In 2002, following a recommendation by Finance Committee, Council extended the ‘line of credit’ from 2003 to 2006. This time the stated majority requested was ‘simple majority’ with the final vote being eight in favour, one against (FR) and one abstention (DK).

In the end, delays in the project meant that the ‘line of credit’ was not used and ESO borrowed short-term between 2000 and 2004 only. This short-term borrowing was repeated in 2012 and 2013 towards the end of the ALMA construction programme.

4.6 The EIB Facility

An agreement with the EIB, falling under the Risk Sharing Finance Facility (RSFF), in pursuance of a joint initiative between the EIB and the European Commission to finance *inter alia* research projects and research infrastructures, was signed in November 2012. Under this agreement, ESO can have access to up to 300 MEUR at a very favourable interest rate (0.1% above EURIBOR). Repayment can be made at any time and without penalties.

There have been numerous discussions about how such a facility should be treated. To resolve this matter, ESO commissioned an authoritative external study (Annex A of doc. ESO/Cou-1566 dated 14.10.2014). This study confirms that an EIB facility would not need to be accounted for in MS books (by NNI), as neither are ESO’s assets.

In terms of precedents, there have been several other organisations authorized to use an EIB facility: CERN used it during the construction of the LHC. For the ESRF, BE, CH, DE, DK, ES, FI, FR, IT, NL, SE and UK unanimously authorized an EIB loan in December 2015. The ESS is in the process of seeking approval for a similar approach.
Based on this, there should be no barrier to ESO using the EIB facility. In this case the required voting majority would be:

- Two-thirds of all Member States in Council (legal basis is the analogy to Art. V (2.b) of the Convention relative to the ESO budget and the 1995 precedent), and
- A Finance Committee recommendation would not formally be needed because it is not included in the List of Attributions of the Finance Committee, but Council could request it. It would require simple majority (legal basis is Rule 9 (4.2) of the Rules of Procedure for the Finance Committee and the 1995 precedent).

5 Risk Mitigation

The approach proposed is to limit the overall cost and risks of the construction of the E-ELT by placing the remaining Phase 1 contracts on schedule for first light in 2024.

To achieve this, an improved cash flow is mandatory and will be addressed through:

- A slower ramp-up of operations offsite funding (including additional instruments);
- Encouraging advance payments by the Member States, for example on the E-ELT additional lump sum contributions;
- Accession of new Member States in the next few years. Several countries are being pursued (BR, IR, HU, NO, ...). Of course the outcome is at present uncertain, although the probability of attracting new Member States increases if the E-ELT is ahead of the competition;
- Acquiring a partner for the E-ELT programme. The current delicate situation of the TMT project may have unexpected consequences, providing an opportunity;
- Using the EIB facility for phasing of the cash flow, and
- Noting that schedule slips may occur during construction, delaying payments and hence easing cash flow demands.

This approach has a number of boundary conditions, set by Council’s 2004 Resolution on Scientific Strategy (Annex 2):

- VLT and VLTI operations and instrumentation are protected. The 2\textsuperscript{nd} generation instruments and infrastructure upgrades will be completed by 2019, after which the required effort drops, but cannot be cut further. The support of the VST by ESO is not secured post 2021, and
- The ALMA share and financial contribution remain at the current level with no major additional development until after E-ELT construction.
Activities potentially at risk, despite their high scientific value, are the extension of APEX for the period 2018-2022, extension of La Silla operations for another decade as a platform for follow-up of transients (including those provided by LSST) and of complementary data for ESA’s PLATO mission, and equipping VISTA with the 4MOST instrument. In addition, the timing of implementation of high-priority components of E-ELT Phase 2 (LTAO, M1 segments, second pre-focal station) and of the future E-ELT instruments MOS, HIRES and PCS may be affected.

5.1 Cash Flow to support the DMS contract

Figure 3 below shows the financial requirements implied by Figure 1, resulting from the award of the Phase 1 E-ELT contracts placed to date, including that for the DMS, all consistent with first light in 2024, and the use of the updated financial assumptions detailed in Section 7 below. As in Figure 1, the placement of the remaining contracts has been artificially stretched leading to first light of the Phase 1 E-ELT in 2026. This figure can be considered as an update of Figure 8 in doc. Cou-1553 rev 3 conf.

![Figure 3: The cash flow situation without Brazil, E-ELT Phase 1 only, the DMS contract in place and consistent with 2024, but with other contracts delayed to reach First Light in 2026 and with the updated assumptions on exchange rates as detailed in Section 7 below.](image-url)

In this scenario there are no advance contributions from the Member States, and no new Member State joins the current 15. This scenario was shown to Finance Committee on 3 February 2016 as part of the DMS contract approval process. It can be seen that, in this very
conservative scenario, the EIB facility would have to be used starting end of 2022. Three contracts are to be placed with the EIB: 50 MEUR for 12 months, 100 MEUR for 30 months, and 50 MEUR for 12 months. The total interest charged would be 1.4 MEUR based on a 0.4% interest rate (today’s rate is 0.1%).

5.2 Securing the CLP/EUR rate

As is to be expected, there is a significant CLP component in the DMS contract. Figure 4 shows an indicative offer from Société Générale made on 21 January 2016 to hedge the CLP. Remarkably there are savings of more than 20 MEUR possible compared to the budget assumptions. It is therefore intended to seek Finance Committee approval to place such an agreement immediately after signature of the DMS contract.

<table>
<thead>
<tr>
<th>Date</th>
<th>Amount in million CLP</th>
<th>@750 budget rate in MEUR</th>
<th>offered rates in SG</th>
<th>@ offered rates in kEUR</th>
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<td>3 602</td>
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<td>-22 090</td>
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</tbody>
</table>

Figure 4: Indicative savings from hedging of the CLP component of the DMS contract.

It is important to realize that ‘hedging’ is securing the exchange rate and is not speculation. It simply fixes the CLP/EUR rate at future dates. This secures actual payments to be made, reduces uncertainties on evolution of expenditure and hence lowers risk and cost.

In such a scheme, payments come at specific dates. What would happen if a milestone payment for the DMS was delayed? This would not cause a problem since close to 40% of ESO’s spending is in CLP, and is very predictable. Any DMS CLPs not used if there is a delay can be used for normal operations spending. This means that it is also safe to secure the CLP/EUR rate for about 50% of operations spending as well.
6 New Member States

It is clear that the DMS decision has signalled to the world that ESO is taking the lead in building an ELT while operating and upgrading the La Silla Paranal Observatory and partnering in ALMA which has recently entered operations. As expected, this is increasing interest in membership of ESO. It is therefore appropriate to consider the impact of significant additional income committed by new MS during the next few years. Figure 5 shows the growth of ESO over the years and the large increase following the start of VLT operations and approval of ALMA construction.

Figure 5: The growth of ESO over the years.

Candidate Member States and their potential impact on ESO income include:

- Brazil – Accession would solve the cash-flow issues even if the Brazilian NNI is now lower than earlier forecast;
- Ireland – The Government has asked to start formal negotiations. The first meeting will take place in early July 2016 – 1.8 MEUR/yr and 13.9 MEUR for funding of ESO membership entrance fee (1.0%);
- Hungary - Astronomers have submitted an internal request – 1.0 MEUR/yr and 8.1 MEUR entrance fee (0.58%);
- Norway - Astronomers are preparing an internal application to join ESO – 5.0 MEUR/yr and 38.2 MEUR entrance fee (2.75%), and
- Progress in Australia (7.66%) is slow – commitments to SKA and GMT complicate matters.
7  Funding Scenarios for First Light in 2024

There now follows a series of scenarios which illustrate the financial impact of various possible actions or external events when placing all contracts on a schedule aimed at achieving first light in 2024.

All scenarios are based on the following assumptions:

- Exchange rates:
  - CLP for 1 EUR: 780 as from 2016;
  - CHF for 1 EUR: 1.15 in 2016 and 2017, 1.2 as from 2018 onwards;
  - USD for 1 EUR: 1.1 in 2016, 1.15 in 2017-2019, 1.25 as from 2020 onwards;
- New Pension Fund scheme in place since 1 January 2014 for new staff members (with estimated 8% annual staff turnover);
- Interest rates: 0.7% for short-term borrowings, 0.4% for EIB loans (today’s rate 0.1%) and 0.75% on deposits/investments, and
- All figures in 2016 prices.

7.1  Scenario 1: CLP hedging for DMS only, no new MSs

Figure 6 below shows scenario 1 where E-ELT (Phase 1 only) is delivered without Brazil. The CLP is hedged for the DMS contract only and no new Member States are assumed.

![Figure 6: E-ELT Phase 1 only and without Brazil. With CLP hedging for the DMS contract only, no new Member States assumed.](image-url)
The EIB facility is used starting end of 2019, and would be split in four contracts: 50 MEUR for 21 months, 90 MEUR for 23 months, 120 MEUR for 32 months, 75 MEUR for 24 months. The total interest would be 2.9 MEUR (estimated at 0.4% interest rate, today's rate is 0.1%).

7.2 Scenario 2: CLP hedging for DMS and 50% of operations costs, no new MSs

In scenario 2 (Figure 7) in addition to the assumptions in scenario 1 (E-ELT Phase 1 only, no Brazil, no new MSs), the CLP is hedged for both the DMS contract and for 50% of ESO operations costs in Chile. It can be seen that this action reduces the cash flow significantly.

Figure 7: E-ELT Phase 1 only and without Brazil. CLP hedging included for both the DMS contract and for 50% of operations costs in Chile, no new MS.

The EIB facility is used starting end of 2019, again split in four contracts: 50 MEUR for 23 months, 75 MEUR for 23 months, 100 MEUR for 31 months, 50 MEUR for 22 months. Total interest would be 2.4 MEUR (estimated at 0.4% interest rate, today's rate is 0.1%).
7.3 Scenario 3: CLP hedging for DMS and 50% of operations costs, lump sum for E-ELT paid by 2018, no new MSs

Table 1 below shows the status of the lump sum contributions as at 31.12.2015 by the Member States. It has been possible for some Member States to pay in advance of the plan. Further advancing the lump sum payments by some other Member States will help with the cash flow and reduce the size of a potential EIB facility needed. The last column shows the saving on indexation for each Member State able to pay the remainder of the lump sum in 2018.

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<th>Member State</th>
<th>Total paid up to 2015</th>
<th>Total remaining at 31.12.2015</th>
<th>2016</th>
<th>2017</th>
<th>2018-2025</th>
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<td>28 556</td>
<td>5 964</td>
<td>4 528</td>
<td>18 064</td>
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</tbody>
</table>

* assuming 2% yearly indexation

Table 1: Status as at 31.12.2015 of lump sum contributions

Scenario 3, shown in Figure 8 below, shows the impact of the lump sum being paid in full by 2018 by all Member States, in addition to all the assumptions of scenario 2 (ELT Phase 1 only, no Brazil, no new MSs, CLP hedged for both the DMS contract and for 50% of ESO operations costs in Chile). It is not proposed that all Member States should commit to advancement of payments but they will be encouraged to explore the possibility. Any such advancement improves the cash-flow situation.
7.4 Scenario 4: With CLP hedging for DMS and 50% of operations costs, lump sum paid by 2018, Ireland joining 2017

Scenario 4 (Figure 9 below) adds Ireland as a new Member State joining in 2017 in addition to the assumptions of scenario 3. This significantly improves the cash-flow.

Figure 9: E-ELT Phase 1 only and without Brazil. With CLP hedging included for the DMS contract and 50% of operations costs in Chile, the lump sum paid in full by 2018, plus Ireland joining ESO in 2017.
The EIB facility is used starting at the end of 2021. Three contracts: 40 MEUR for 21 months, 75 MEUR for 20 months, 40 MEUR for 22 months, for a total interest of 1.1 MEUR (estimated at 0.4%, today’s rate is 0.1%).

7.5 Scenario 5: With CLP hedging for DMS and 50% of operations costs, lump sum paid by 2018, Ireland joining 2017, Norway joining 2018

Finally in scenario 5 (Figure 10) a second new Member State (Norway) is added in 2018. Only short term borrowing (up to ~130 MEUR) is now required. The peak in January 2024 of 150 MEUR can be dealt with via cash management.

Figure 10: E-ELT Phase 1 only and without Brazil. With CLP hedging included for the DMS contract and 50% of operations costs in Chile, the lump sum paid in full by 2018, with Ireland joining ESO in 2017 and with Norway joining in 2018.
7.6 Scenario 6: Brazil

If Brazil were to join ESO in 2017, no other new Member States join, and the lump sum payments continue to be made according to the currently agreed schedule, but with the CLP hedging for the DMS and for 50% of the operations costs in Chile, then only short term borrowing up to ~65 MEUR would be needed.

In this case it would in fact be possible to return to the baseline plan, i.e. include Phase 2, and ramp up E-ELT operations (both onsite and offsite) and the instrument development line as originally foreseen without the need to access the EIB facility or increasing the peak of short term borrowing above 100 MEUR.

7.7 Conclusions

The various scenarios as shown demonstrate that it is possible to place the remaining contracts for the Phase 1 E-ELT on the schedule that leads to first light in 2024. This may require use of the approved EIB facility by 2019 if no other Member State joins ESO and if it is impossible for Member States to advance contributions relative to the currently agreed schedule. The analysis also shows that the accession of new Member States in the next few years has a significant impact on the cash position of the Organisation lowering the cash-flow risk in the middle years of the E-ELT construction.

8 Phase 2 and additional instruments

Phase 2 of the E-ELT is currently unfunded. Its components were prioritized in doc. ESO/Cou-1553 rev 3 conf. In the bleakest future scenario (no Brazil, no other new Member States, no additional funding), most of these would have to be postponed to a later date.

The funding required for the highest priority item, the LTAO module, is relatively modest. The contract for the polishing of the M1 segments will be submitted to the Finance Committee for approval in November 2016 with the proposal for the blanks to follow in May 2017. Both will have options for provision of the extra segments for the five inner rings of M1 and for the turn-around segments. A decision will need to be made in 2020 at the earliest whether or not to exercise these options. It should be noted that having the turn-around options may simplify operations activities which would lower costs. Having the inner rings in increases the sensitivity of the telescope. Work has started to identify the optimum way forward in case (some) extra funding becomes available. This will be reported to Council in due course.
The Phase A design of the MOS and HIRES instruments is covered by the Phase 1 E-ELT construction budget. The ESO contribution to the construction of these instruments (and also of the Planetary Camera Spectrograph) will however be financed from the E-ELT offsite operations budget (i.e. not as part of Phase 2). In the bleakest scenario, this budget line ramps up slower than foreseen earlier which may have an impact on the timeline for these instruments. In addition, they would need the second prefocal station to be procured, which is part of Phase 2.

It is clear that staying on track for first light in 2024 lowers cost and risk on the Phase 1 E-ELT and brings first light two years earlier than otherwise. This also means that it helps bring the additional components forward, even though the potential use of the EIB facility would mean a period of repayments. As soon as a new Member State joins, Council could decide whether to improve the cash position of the Organisation or instead to bring forward components of the E-ELT Phase 2 and/or instruments funded from the operations line.

9 Way Forward

ESO is poised to take the world-leading role in ground-based astronomy by keeping the VLT and the VLT Interferometer at the forefront, scientifically exploiting ALMA and by building the first (and most powerful) of the new generation of giant telescopes, with first light for the Phase 1 E-ELT in 2024. This is fully in line with Council’s Resolution on Scientific Strategy of 2004 (Annex 2), and can be achieved without asking for extra funding from the Member States and without sacrificing the existing programme. It requires a pro-active approach to the potential cash-flow challenge by placing the E-ELT Phase 1 contracts on the baseline schedule, limiting cost and risk and providing earlier geo-return to the Member States.

To limit costs and risks, the ESO Executive will:
  • Secure the CLP/EUR exchange rate;
  • Encourage advance payments by Member States;
  • Continue to take a pro-active approach towards candidate Member States, and
  • If needed, use the EIB facility starting in 2019. The repayment period will be shortened whenever a new Member State accedes. The interest payments would be much less than the cost of extending the construction schedule by two years.

This requires an action by Council now because five contracts need to be presented to Finance Committee for approval in November 2016 in order to stay on schedule for first light in 2024, and Council needs to note the potential risk on the cash-flow. Most of the CfTs are running or need to be released soon. Once offers are received, the delivery date cannot be changed without a major impact on cost and/or schedule. If they can be placed by late 2017, then most contracts for the Phase 1 E-ELT will be committed, reducing costs and risks.
The Scientific and Technical Committee were briefed on the proposed way forward during its meeting on 26 and 27 May 2916. It reconfirmed its strong support for staying on track for First Light in 2024. At Council’s request, the original version of this document was sent to Finance Committee for information. This resulted in a constructive discussion during its meeting on 3 and 4 May 2016, and suggestions for improvement of the text, which are included in this revised version.

10 Voting procedure

The approval of a supplementary programme requires a two-thirds majority of all Member States (Article II paragraph 3 of the Convention). On this basis, the approval of the E-ELT was required to be approved by two-thirds majority of all Member States (doc. ESO/Cou-1452 dated 22.05.2012)¹.

Neither the Convention nor the List of Attributions of the Finance Committee (Annex II of the ESO Financial Rules and Regulations, unanimously approved by Council on 09-10.12.2009) stipulate that the Finance Committee is required to provide a recommendation to Council prior to the approval of a new supplementary programme. The same applies to the STC². Nevertheless, the STC recommended Council in October 2011 to approve the E-ELT construction proposal at the earliest possible time in order to retain ESO’s world-leading position in ground-based astronomy, and reaffirmed this during its meeting in April 2012 (doc. ESO/STC-504). Finance Committee made a recommendation to Council in relation to endorsement of the proposal for E-ELT financing as a supplementary programme, which was unanimously approved by Council in December 2011 (doc. ESO/Cou-1431 dated 18.05.2012).

¹ In June 2012, ten Member States (Austria, the Czech Republic, Germany, the Netherlands, Sweden, Switzerland, Belgium, Finland, Italy, and the United Kingdom) voted in favour. However, the latter four Member States voted ad referendum. Of these ad referendum votes, Belgium confirmed its vote in October 2012, and at the Council meeting of 3 - 4 December 2012 Finland and Italy also confirmed their ad referendum votes. In addition, France also voted in favour. Thus, the date of formal approval of the construction of the E-ELT should be considered 4 December 2012. The confirmation of the United Kingdom’s ad referendum vote was received on 3 March 2013. Denmark joined the E-ELT on 12 March 2013, Portugal on 7 May 2013 and Spain on 3 June 2014. Poland joined the E-ELT as part of its accession to ESO on 8 July 2015.

² In the Terms of Reference of the STC approved by Council in December 2013 (Annex 1 to doc. ESO/Cou-1513 dated 08.10.2013) it is stipulated that “The STC shall [...] advise Council and the DG on scientific priorities for projects and programmes, and the equipment, maintenance and upgrade of ESO facilities upon the request of Council or the DG”.
In December 2014 Council approved a Resolution concerning the adoption of a two-phase approach for the construction of the E-ELT (Annex 1). As this Resolution partially amended the 2012 Council Resolution for the approval of the E-ELT, the same voting majority was required, i.e. two-thirds of all Member States in Council.

Annex 3 to this document partially amends the content (number 2) of the 2014 Council Resolution. Therefore, the same voting majority will be required, i.e. two-thirds of all the Member States in Council.

11 Council Action

Council is invited to approve the Resolution contained in Annex 3.
Annex 1: Resolution approved by Council on 03.12.2014 (doc. ESO/Cou-1553 rev 3 conf.):

NOTING that the ESO Council approved the construction of the E-ELT and its first instruments in 2012 (Resolution in Annex A to doc. ESO/Cou-1452) and that the supplementary programme has been joined by all Member States

RECALLING that approval of the E-ELT construction was granted subject to the condition that spending on major items (defined as exceeding a single cost in excess of 2M€), other than building the road and flattening the mountaintop, will not commence until 90% of 1083 M€ cost-to-completion in 2012 prices will be pledged

CONFIRMING that all Member States remain committed to construct the E-ELT on a competitive timescale

NOTING that in the current planning the 90% threshold will be reached with the accession of Brazil as a Member State through the ratification of the Accession Agreement signed on 29 December 2010 and of the ESO Founding Texts

TAKING NOTE that the Brazilian ratification procedure is making progress, but is taking longer than expected, to the point that this delay is about to have an impact on the current E-ELT baseline construction plan, which foresees first light in late 2024

NOTING that ESO Council has unanimously approved the accession of Poland to ESO during its 132nd extraordinary meeting on 8 October 2014 in Turku and that, consequently, the Polish Accession Agreement was signed by the Polish Minister of Science and Higher Education and by the ESO Director General on 28 October 2014

RECOGNIZING that it is essential for ESO to stay within the baseline construction schedule as delaying the procurement of major items will increase the cost of the project, risk the viability of the instrument teams, erode science opportunities, disengage industry and damage the reputation of the Organisation

WHILE expressing high expectations that Brazil will complete its ratification procedure soon, ESO Council:

DECIDES:

1. That the construction of the full E-ELT is carried out in two Phases with Phase 1 as described in Section 6 of this document

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3 Poland completed the ratification procedure and is a Member State of ESO since 8 July 2015.
2. That the construction period of Phase 1 may extend until 2026 for a cost-to-completion of 1012.5 MEUR in 2014 prices. This amount is fully funded within the annual budgets of ESO without any additional contributions from the Member States, other than those currently approved for the E-ELT (additional contribution of 255 MEUR in 2012 prices and planned 2% increases year-on-year above inflation until 2021), and does not require long-term loans for investments from financial institutions.

3. To authorise, independently of progress in the Brazilian ratification process, spending on major items for Phase 1, i.e., the required procurement contracts with a single cost of more than 2 MEUR.

4. That a Council decision to authorise the start of Phase 2, or some of its elements, is deferred until sufficient funding is available, with the understanding that if the Brazilian ratification procedure is completed before 2017 first light of the full E-ELT will be brought forward to 2024.

5. That in accordance with the Terms of Reference of the E-ELT Management Advisory Committee, approved by Council on 4-5 March 2014 (doc. ESO/Cou-1509 conf. rev.), this Committee shall advise Council and the Director General on how and when external reviews shall be conducted. It shall meet first in early 2015.

ESO Council, considering the report of its Working Group for Scientific Strategic Planning, ESO/Cou-990, and its recommendations in ESO/Cou-964 rev. 2, agrees that

- Astronomy is in a golden age with new technologies and telescopes enabling an impressive series of fundamental discoveries in physics (e.g. dark matter, dark energy, supermassive black-holes, extrasolar planets)
- Over the last decade, the continued investment of ESO and its community into the improvement of ground-based astronomical facilities has finally allowed Europe to reach international competitiveness and leadership in ground-based astronomical research
- The prime goal of ESO is to secure this status by developing powerful facilities in order to enable important scientific discoveries in the future
- Only the continued investment in cutting edge technologies, telescopes, instruments and information technology will enable such scientific leadership and discoveries
- ESO will continue to be open to new members and collaborations, following the principle of furthering scientific excellence

and accordingly adopts the following principles for its scientific strategy:

- ESO’s highest priority strategic goal must be the European retention of astronomical leadership and excellence into the era of Extremely Large Telescopes by carefully balancing its investment in its most important programmes and projects
- The completion of ALMA is assured and conditions for an efficient exploitation of its superb scientific capabilities will be established
- The VLT will continue to receive effective operational support, regular upgrading (especially to keep it at the forefront in image quality through novel adaptive optics concepts) and efficient 2nd generation instrumentation in order to maintain its world-leading position for at least ten more years
- The unique capabilities of the VLTI will be exploited
- The construction of an Extremely Large Telescope on a competitive time scale will be addressed by radical strategic planning, especially with respect to the development of enabling technologies and the exploration of all options, including seeking additional funds, for fast implementation
- ESO and its community will continue their successful partnership and seek effective intercontinental collaborations in developing the most important and challenging technologies and facilities of the future.
Annex 3: Resolution which the ESO Council is invited to approve during its meeting in June 2016 for the authorisation of placing Phase 1 E-ELT procurements on the baseline schedule leading to first light in 2024

RECALLING the Council Resolution on Scientific Strategy of December 2004 (doc. ESO/Cou 991 rev), which includes as objective the construction of an extremely large telescope on a competitive timescale;

WHEREAS the ESO Council approved the construction of the E-ELT and its first instruments in 2012 (Resolution in Annex A to doc. ESO/Cou-1452) and that the supplementary programme has been joined by all Member States;

NOTING that the ESO Council approved a Resolution concerning the adoption of a two-phase approach for the construction of the E-ELT and authorising spending on major items for Phase 1, with the understanding that first light should be, if possible, be brought forward to 2024;

CONFIRMING that all Member States remain committed to construct the E-ELT on a competitive timescale;

TAKING NOTE that the authorisation to start Phase 2, or some of its elements, requires a Council decision and is deferred until sufficient funding is available;

RECALLING that making use of the EIB Agreement concluded in November 2012 would require a prior Council decision;

RECOGNISING that it is essential for ESO to stay within the baseline construction schedule of first light in 2024 to reduce the cost of the project and to secure its cost-to-completion, to maximise science opportunities, to fully engage industry and to preserve the high reputation of the Organisation;

Council AUTHORIZES placing all E-ELT Phase 1 procurements on a baseline schedule leading to first light in 2024, which might require taking up a loan from the EIB.
Annex 4: Contracts that would be delayed for First Light in 2026

<table>
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<tr>
<th>E-ELT Phase 1 Contracts (≥ 0.5 MEUR)</th>
<th>Foreseen Kick-Off FL 2024</th>
<th>Foreseen Kick-Off FL 2026</th>
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</tr>
<tr>
<td>M2 Blank</td>
<td>Q1-17</td>
<td>Q1-19</td>
</tr>
<tr>
<td>M2/M3 Cells</td>
<td>Q1-17</td>
<td>Q1-19</td>
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<tr>
<td>M3 Mirror Polishing</td>
<td>Q1-17</td>
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</tr>
<tr>
<td>M1 Segments Polishing</td>
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</tr>
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<td>M1 Edge Sensors</td>
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</tr>
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<td>M1 Position Actuators</td>
<td>Q2-17</td>
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<tr>
<td>Telescope Core Integration Infrastructure</td>
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<td>M1 Segments Blanks</td>
<td>Q2-17</td>
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<td>PFS A</td>
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<td>Optical Control – Calibration Unit</td>
<td>Q1-18</td>
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<td>Mirror washing and Coating units (M1)</td>
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<tr>
<td>Telescope Real Time Control Infrastructure</td>
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<td>Science/Adaptive Optics Detectors/WFS</td>
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<td>M1 Segment Supports</td>
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<td>M1 Segment Assemblies Manipulator</td>
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<td>M5 Mirror</td>
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<td>Software development contract</td>
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<td>M5 Electro-mechanic Unit</td>
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<td>Laser Sources</td>
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<td>M1LCS - Cabinets</td>
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<td>Telescope Test Camera</td>
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<td>Mirror coating unit (5m mirror class)</td>
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