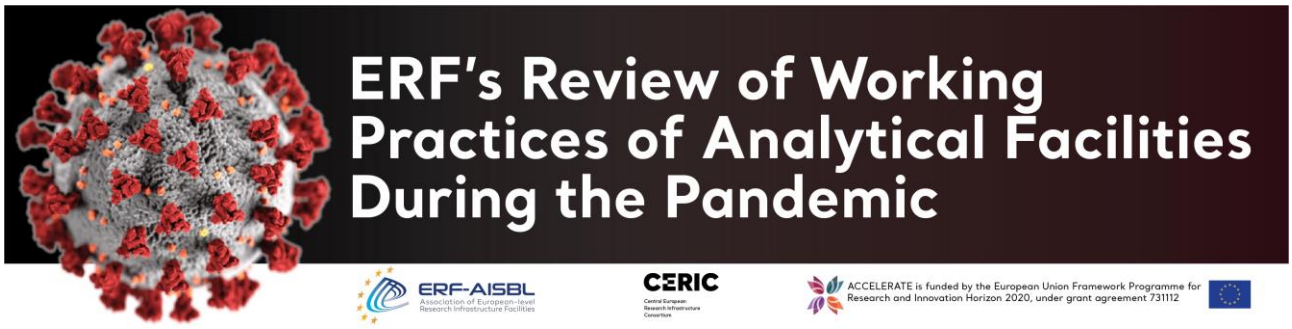

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EXECUTIVE SUMMARY

The on-going COVID-19 pandemic has strongly impacted the operations of analytical facilities. To protect their staff, several research infrastructures (RIs) are closed for operations or strongly limiting their activities while maximizing protection measures, while some others provide limited access to external researchers (users), primarily for COVID-19 related research. Yet, the crisis is likely to last for months and all facilities are considering restarting their services, albeit remotely and/or with limited scale. To assist RIs in this transition, the Association of European-Level Research Infrastructures Facilities (ERF) has invited the national and international analytical (experimental) facilities located in Europe that are open to international users to describe their working practices by replying to a questionnaire.[1] As of April 21st 2020, 27 RIs, mainly European synchrotrons, neutron sources and laser research infrastructures, listed in Annex 1, have submitted their replies. This report summarises their responses, and also discusses some of the issues and possible future decisions faced by the analytical facilities in the time of the pandemic.

The report first gives an overview of the current level of operations offered by the responding facilities[2]. Their responses confirm that the pandemic has had a profound impact on the operations of these RIs. The pandemic has brought many parts of the world to a standstill and, as a result, external users are unable to provide the samples for the scheduled measurements at the facilities. In addition, travel bans, together with local safety concerns at RIs, prevent users, who might have samples, from performing measurements. Furthermore, the required safety measures have also forced many research infrastructures to interrupt their services, at least temporarily. As a result, only 9 of the 27 respondents have reported to serve external users. All but one of these facilities have set up specific support services on COVID-19 related research. 5 of the RIs continue to support also research of external users in other domains, but the staff and the available instruments are generally reduced. This is to increase safety, but also due to fact that most of the scheduled experiments are cancelled.

A marked change is also a strong shift towards remote services for external users, which allows samples to be mailed in. As a response to the current travel limitations, several of the responding organisations are working on expanding their offer of remote access, limited so far to specific instruments such as macromolecular crystallography beamlines at synchrotrons, by extending it to other instrumental set-ups. Since the COVID-19 crisis will likely require a prolonged and widespread provision of remote access to the instrumentation across the RIs, it is proposed that the facilities, as a priority, introduce remote services wherever possible. In addition, many instruments should be modified in ways that reduce the number of the required staff for their operation to one, thus allowing for the necessary social distancing. However, generally, more staff will be needed to provide continuous support to the users performing experiments remotely and such experiments are likely to require more time. Consequently, measures should be put in place to increase their throughput. Introduction of remote instrument control, where possible, would contribute to the safety of the staff, improve efficiency and facilitate the analysis of mailed-in samples. This approach should

[1] https://docs.google.com/forms/d/e/1FAIpQLSdjYy4Ghbb4Olwy1CHWhapAnk7fSv8b8iikgHkz6qIBjI2ukQ/viewform

[2] Seven RIs have indicated that they wish their responses to be treated anonymously. Therefore, the examples referring to specific institutions are presented only for those who have agreed to their names being used in the report.

optimally be coordinated across similar facilities in order to develop and share high-quality, innovative solutions. Such a concerted approach would facilitate adoption and acceptance of these new developments since user communities and experts on instruments are historically structured around each type of analytical facilities. There would be some merit too in sharing best practice and plans for developments across RIs that have some common elements of operations, for example synchrotrons and FELs with laser and neutron facilities.

Widespread adaptive measures are needed to prevent RIs from having to durably and significantly limit their services during the pandemic. Such limitation might come with detrimental effects on the ability of RIs to contribute effectively to the development of solutions to other pressing societal challenges, such as climate change or cancer. In addition to the review of the current level of operations, the report summarises the safety measures put in place by the RIs in order to enable safe operations during the pandemic. The collected practices address issues such as on-site presence authorisations, protective measures for vulnerable staff, support to the staff working from home, cleaning and staff safety-related instructions and use of protection equipment such as masks, gloves, clothing. While the World Health Organisation (WHO) as well as many European countries provide general instructions regarding the safety of personnel, it is hoped that these collected practices, some of which are specific to analytical facilities, will contribute to the safe and swift re-launch of operations and services provided by these research infrastructures, but also, more broadly, by European research performing institutions.

OPERATIONS IN THE TIME OF PANDEMIC

LESS THAN HALF OF THE RIS ARE IN OPERATION

The pandemic has strongly affected the working practices of most of the responding RIs. While one third (9/27)[3] remained in at least partial operations when the pandemic broke out, the others had to shut down operations for a few weeks, one even for a few months. However, by the time of the submission of the replies to the questionnaire, almost half (13/27) are at least partially in operation, though only nine offer services to external users.

THE SERVICES ARE LARGELY DEDICATED TO COVID-19 RESEARCH

In addition to limiting or affecting operations, the pandemic has also had a marked effect on the type and conditions of the work performed. Out of the 9 facilities currently offering services to external users, all but one have services dedicated to COVID-19 research and 5 continue to support external users working on other topics. The 4 other organisations in operations, but not serving external users, perform only internal research. It has to be stressed that, in many cases, the decision whether to close down operations or to continue serving users depends on the national measures decided by the State or regional authorities, rather than on the sole decision of the facility itself.

Operations are not only largely dedicated to COVID-19 research, but also downsized, as the number of instruments and the staff is decreased in 11 out of 13 RIs in operation. In several institutions,

[3] Number of institutions that have replied positively/number of all RIs that have replied to the specific question

only the instruments capable of contributing to COVID-19 research are running and the number of staff present at those instruments are reduced to diminish risks to safety.

- Diamond Light Source ('Diamond'), for example, reports that only a small number of beamlines requested for COVID-19 research plus 2 Cryo-EM instruments are running so far, though there are plans to extend this to a wider range of remote access. Staff levels are reduced to a total of about 20 staff during the day, including people to receive samples when they arrive, to store samples safely and transfer to the beamline, and to maintain machine operations as well as a team of cleaners. Most beamlines run with only occasional intervention.
- At European XFEL, the activities aimed at contributing to research related to SARS-CoV2 started in mid-April, followed by the first steps towards re-start of the facility and a normal, more regular operation at the beginning of May. At ALBA, the activity is to start with only one person per beamline, with only part of the beamlines operating, and progressively increasing. Small tasks of installation and maintenance are allowed, depending on the priority level and the possibility of developing with single or at maximum two people working together. COVID-19 research is always allowed, minimizing the involved staff and with strong attention to precautionary measures.
- At PSI, the Swiss Light Source is operating for COVID-19 as well as other research, though external users are not allowed on site. MX beamlines are in 100% remote access mode, while other beamlines offer mail-in mode for external users with varying degrees of support by in-house staff. There are limitations to the range of experiments that may be supported, for example where complex operations require close proximity of workers on the beamline, or chemical hazards mean that lone working is not compatible with safety requirements. One regular shutdown has already been postponed to allow COVID-19 research to continue, and operations are 24/5 rather than 24/7.
- The ESRF site is currently closed, operation conditions are halted and kept in stand-by conditions, implementing the ESRF Continuity Plan for pandemic. During this time, one agent per instrument is on call and eventually available on five instruments selected to be used in case urgent scientific research on COVID-19 is required by the user community

USERS ARE SERVED REMOTELY

In addition to a shift towards COVID-19 related research and limited operations, another marked change during the pandemic is the almost complete use of remote analysis, whereby the samples are mailed in and then analysed without the presence of the users on site. Several institutions were offering remote access already before the crisis; for example, several synchrotrons have remote access to their MX beamlines, though such remote access is much less common on other types of beamline.

It is clear that the current pandemic will have long-ranging consequences on the delivery of services by analytical facilities to their users. Travel restrictions and the need for social distancing require that facilities develop innovative solutions to enable remote access to their instruments, whenever possible. Due to COVID-19, ELETTRA and CERIC are currently jointly accelerating remote access to the beamlines at ELETTRA using new advanced technologies, including secure web-based remote

access via edge computing to all the beamline control, data acquisition, data processing and analysis application, remote access to the acquired data during and after the experiment, collaborative experiment execution and remote presence via videoconference, real-time chats, voice user interfaces and telepresence robots. At ESRF, pre-existing sample mail-in and user remote access have been in place for a few instruments since before the COVID-19 pandemic. These procedures will soon be extended to almost every user-dedicated instrument.

In addition to these modifications in support of remote access, further adaptations should also enable experiments to be performed under the requirements of social distancing, while not affecting the throughput of analysed samples. It is proposed that funders, optimally the European Commission, support these adaptations in order to enable the development of optimal solutions for certain types of facilities, such as synchrotrons or neutron sources. A coordinated, standardised approach, involving also the user communities, would certainly be welcomed by the researchers that these facilities serve.

SAFETY MEASURES PUT IN PLACE TO ENABLE SAFE OPERATIONS DURING THE PANDEMIC

Almost all (23/27) of responding institutions report having established dedicated COVID-19 safety protocols. Often, they are disseminated to staff through email, although some institutions have published them on their web pages (Annex 2), or both.

In the following, some of the safety measures are presented in more detail.

ON-SITE PRESENCE AUTHORISATIONS

In most cases, only approved staff can enter the facility, while an authorisation is needed for the rest. HZB reports that the granting of access to BESSY-II depends on whether the entrance is needed and requires a self-declaration that there was no contact to infected people for 3 weeks. At ILL, it is granted after a medical auto-test with a possibility to refer to the Occupational Health Doctor. At SOLEIL, no more than 5 persons are allowed at the same time on site and exceptions are discussed every day and validated by the SOLEIL Directorate. Diamond has an electronic approval process for who is allowed into its buildings, with sign-off by the Director of the appropriate. Anyone coming on site must also have completed on-line safety training related to COVID-19. At ALBA, the Director approves a weekly plan prepared by the Coordination Office, defining tasks and staff allowed in the facility, who follow a specific and mandatory on-line safety training. At the time of writing, less than 10% of the total staff can simultaneously be present at the facility. External security staff and representatives of the external cleaning company are allowed to enter, while authorization is needed for external companies only for urgent needs under very strict conditions. At European XFEL, about 30% of the staff can be allowed on site since May 4th. Specific hygiene guidelines were put in place and accompanied by an online training, which must be accomplished by all staff accessing the campus.

TREATMENT OF VULNERABLE PEOPLE

Most of the facilities in operation have identified staff who are vulnerable or who have caring responsibilities for vulnerable people. At several institutions such as ALBA, DESY, Diamond, ELI Beamlines, NIMP, NMR-NIC, PSI and ULF-FORTH, these identified staff are not allowed to enter the institution.

STAFF WORKING FROM HOME

Most of the facilities have put in place special measures in support of home working. Mostly, they focus on providing the staff with home office tools, access to internet and safety guidelines and health recommendations are regularly communicated to the staff.

Regarding staff wellbeing, several institutions provide psychologic support and inform the staff about other resources that they can access for advice and help. ALBA provides recommendations on healthy habits, follow-ups of personal situations by supervisors, and the possibility of asking for psychological support. An emergency committee with representatives from management and workers' council meets two-three time per week. Many of these arrangements have also been put in place for Diamond, together with extended guidelines to managers to help maintain social cohesion in their teams and pages on a dedicated new intranet web pages to gather such information, together with all other COVID-19 related information for staff. HZB and Diamond make possible paid leave in cases of hardship. At PSI staff working from home are supported by a wide range of services based on the following three pillars: 1. free webinars on topics such as work technique & time management and work-life balance for a large number of participants, 2. virtual group exchange formats/interactive online seminars with a limited number of participants, 3. individual one-to-one consultations. Parents who are particularly challenged by the situation of combining home office and childcare can book a free one-to-one coaching session (German or English) with an external specialist by e-mail. These services are listed in the daily bulletin of the PSI Pandemic Staff.

CLEANING AND STAFF SAFETY-RELATED INSTRUCTIONS

EU countries have issued instructions to the employers and several of the RI report that they adhere to the national guidelines. Their comparison and evaluation are beyond the scope of this report. Nevertheless, Annex 3 summarises the current practices, based on the recommendations of the WHO[4], internal protocols, and recommendations of the institutions that have responded to the ERF questionnaire.

USE OF PROTECTION EQUIPMENT (E.G. MASKS, GLOVES, CLOTHING)

As with the other recommendations, it is important to keep in mind that the new research on COVID-19, which is published at an unprecedented pace, requires that recommendations, including the use of the protection equipment, be reviewed and potentially adjusted on a frequent basis. At the time of the publication of this report, WHO recommends the use of masks for people who are coughing,

[4] https://www.who.int/docs/default-source/coronaviruse/advice-for-workplace-clean-19-03-2020.pdf?sfvrsn=bd671114_6

sneezing, or taking care of people with COVID-19.[5] On the other hand, some recent research[6] as well as some governments, prescribe the use of non-medical cloth masks in public spaces in order to limit the transmission of particles from the wearer to the outside world, also in the case of asymptomatic carriers of the virus. Regardless of the differences observed in the recommendations, it is important to note that masks are effective only when used in combination with frequent hand-cleaning with alcohol-based hand-rub or soap and water.[5] Also, mask wearers should know how to use them and dispose of them properly.[5]

In most of the responding institutions the use of masks is not mandatory (8/22), nor is the use of gloves (7/22).

CONCLUSION

The Association of European-Level Research Infrastructures Facilities has invited European analytical facilities to report on their operations in the time of pandemic, as well as the specific safety protocols put in place. The responses demonstrate the breadth of the impact that the COVID-19 has had on the operations of the facilities serving international users in the domain of physical science and engineering. While many of the research institutions came to a standstill, several of the research infrastructures did not discontinue their operations or resumed them after a few weeks. However, operations are limited in scale and often focused on supporting the COVID-19 related research. Another major impact of the pandemic on these RIs is the provision of user access almost exclusively remotely and the introduction of safety protocols that protect the staff during the operations of the facilities. These practices, which are summarised in the report, demonstrate the flexibility and responsiveness of the European analytical facilities when faced with a major crisis.

ACKNOWLEDGEMENT

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We thank all European analytical facilities who have contributed to this survey by responding to the questionnaire and reviewing this report.

DISCLAIMER

New findings are published daily and will affect the recommendations. It is advised to update the safety protocols regularly. Consequently, some of the information contained in the report might become outdated. ERF and CERIC shall not be held responsible for the information exhibited herein and its use.

[5] https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public/when-and-how-to-use-masks
[6] Face Masks Against COVID-19: An Evidence Review, Preprint, doi:10.20944/preprints202004.0203.v1

ANNEX 1. RESPONDING INSTITUTIONS AND THEIR ACRONYMS

ALBA Synchrotron, Spain (ALBA)

CEA Paris-Saclay / LIDYL, France

Central European Research Infrastructure Consortium, Italy (CERIC)

Centre for Energy Research, Hungary (BNC)

Coimbra Laser Lab, Portugal

Deutsches Elektronen-Synchrotron DESY, Germany (DESY)

Diamond Light Source, UK (Diamond)

Elettra Sincrotrone Trieste, Italy (ELETTRA)

ELI Beamlines, Czech Republic

European Synchrotron Radiation Facility, France (ESRF)

European XFEL, Germany

Foundation for Research and Technology - Hellas, Ultraviolet Laser Facility, Greece (ULF-FORTH)

Heinz Maier-Leibnitz Zentrum, Germany (MLZ)

Helmholtz zentrum Berlin fuer Materialien und Energie, Germany (HZB)

Helmholtz-Zentrum Dresden-Rossendorf, Germany

Institut Laue Langevin, France (ILL)

Institutions replying to the questionnaire and their acronyms:

Juelich Centre for Neutron Science - Forschungszentrum Juelich GmbH, Germany

Laboratoire d'optique appliquée, France

Laboratoire pour l'Utilisation des Lasers Intenses, France

National Institute of Chemistry - NMR centre, Slovenia (NMR-NIC)

National Institute of Materials Physics, Magurele, Romania (NIMP)

Paul Scherrer Institute, Switzerland (PSI)

PHELIX at GSI, Germany (PHELIX)

SOLARIS National Synchrotron Radiation Centre, Poland (SOLARIS)

ACCELERATE is funded by the European Union Framework Programme for Research and Innovation Horizon 2020, under grant agreement 731112

STFC Central Laser Facility, UK

Synchrotron SOLEIL, France (SOLEIL)

Vilnius University Laser Research Center, Lithuania

ANNEX 2. PUBLICLY AVAILABLE SAFETY PROTOCOLS

ALBA Synchrotron: https://www.albasynchrotron.es/en/covid-19-information/safety-guidelinesrev5.pdf

Deutsches Elektronen-Synchrotron DESY in Hamburg, Germany: https://www.desy.de/coronavirus/index_eng.html

Diamond Light Source: Provides them by email on request

European Synchrotron Radiation Facility, France: https://www.esrf.eu/home/news/general/content-news/general/covid-19-update.html

European XFEL: https://www.xfel.eu/organization/covid19/index_eng.html

Foundation for Research and Technology – Hellas: https://eody.gov.gr/neos-koronaios-covid-19/

Helmholtz zentrum Berlin für Materialien und Energie: https://www.helmholtz-berlin.de/pubbin/news_seite?nid=21180;sprache=en

Paul Scherrer Institute PSI: https://www.psi.ch/en/corona/information-of-the-pandamic-team

Vilnius University Laser Research Center, Lithuania: https://www.ff.vu.lt/mokslo-ir-studiju-naujienos/1188-karantino-metu-paskaitos-nuotoliniu-budu#darbo-fizikos-fakultete-taisykles-karantino-metu

ANNEX 3. CLEANING AND STAFF SAFETY-RELATED INSTRUCTIONS

This annex summarises the current practices, based on the recommendations of the World Health Organisation,[7] internal protocols, and recommendations of the institutions that have responded to the ERF questionnaire as of 21st April 2020. The information presented is a good source of possible safety measures. Nevertheless, it should be considered that various countries or regions have different requirements, and that new findings are published daily. They will affect the recommendations and it is advised to update the protocols regularly. Consequently, some of the information contained in the report might become outdated.

ERF shall not be held responsible for the information exhibited herein and its use.

- Common general instructions provided by employers
    - Promote teleworking;
    - Consider time-scheduled entrance, to avoid too many people present physically at the site;
    - Inform employees regularly of the changes introduced;
    - Define a location where an employee who has fallen sick while at work can wait until safely transported home. Consider setting up of a safe transportation mode.
    - Display posters promoting correct hand washing;
    - Make use that sanitizing hand rub dispensers are placed in prominent places and regularly refilled;
    - Organise work in a way to enable required social distance between employees. If possible, there should be one person per office, two per larger offices;
    - Introduce measure to avoid sharing of the equipment (e.g. keyboards);
    - Promote respiratory hygiene. Provide masks, at least to those with a runny nose or cough at work; Consider using the non-medical masks in public places.
    - Anyone with a mild cough or fever (37.3 or more) should stay at home;
    - Consider closing much of the working areas to keep the area used to the minimum needed;
    - Reduce face-to-face meetings as much as possible. They should be limited to a few people only, while securing the defined interpersonal space;
    - In rooms where several people are present, e.g. during a face-to-face meeting, open windows and doors whenever possible, to make sure the venue is well ventilated.

- General instructions to the employees
    - If you experience symptoms (temperature or new, continuous caught) while you are working, go home immediately. Wait at the designated site until transported by the service provider, in case public transportation is the means of transportation. Please contact your line manager and HR by phone or email once at home. Call your doctor and follow the advice;

[7] https://www.who.int/docs/default-source/coronaviruse/advice-for-workplace-clean-19-03-2020.pdf?sfvrsn=bd671114_6

- Always maintain an interpersonal space of at least 1.5 to 2 m and avoid all physical contact with other people, including touching clothes, handshakes, etc.;
- Follow the respiratory hygiene instructions. In case of a runny nose or cough at work, the use of a mask is obligatory. Some institutions consider mandating the use of non-medical masks in all public places, in confined spaces and in all situations, where the required social distancing cannot be met;
- Adhere to good hand washing practice. Key times are on arrival at work, before departure and on returning home. Also, disinfect hands regularly. Use of gloves should not be a substitute for good hand hygiene and general infection control;
- Avoid touching your eyes, nose, mouth with unwashed hands;
- Clean or dispose of protective equipment after use and do not share it;
- Cover all cuts and abrasions with a waterproof dressing;
- Make sure rooms with several people are properly ventilated. If suitable (e.g. in the absence of appropriate air circulation system), the doors and windows should be open;
- Avoid touching your eyes, nose, mouth with unwashed hands;
- Cover all cuts and abrasions with a waterproof dressing;
- Make sure rooms with several people are properly ventilated. If suitable (e.g. in the absence of appropriate air circulation system), the doors and windows should be open;
- Several countries currently prohibit travel. When allowed, travels should be reduced to the minimum. Follow the institutional guidelines in the case travels are necessary.

- Moving to and around the site
  - If necessary, discuss alternative working hours with your manager in order to avoid using public transport at peak times;
  - Only one person at a time in the cloakroom with hand washing before and after; As far as possible, minimise your movement around the site – restrict to areas where you are located and where you are working. No loitering at printers, in coffee rooms or communal areas. Use of local signage;
  - Whilst moving around site, carry tissue with you and use this to hold door handles. Dispose of the tissue at the end of your journey;
  - Minimise the use of kitchen areas through use of personal drinks bottles, etc. Only use the closest kitchen. The surfaces and items touched whilst in the area should be kept at minimum. Social distancing, hand washing/disinfecting before and after obligatory.
  - For on-site canteen, consider scheduling its use to allow for social distancing. Consider the use of meal packages or catering.

- Cleaning of general surfaces
  - Keep your workspaces clean and tidy. (This is to facilitate deep clean if required).
  - Cleaning of door handles and other surfaces, likely to be touched, several times a day. Non-fire-doors can be propped open to minimise touch contact. Other doors should be kept open;
  - Cleaning the footwear on a wet mat soaked with disinfectant solution;

- For common objects:

In addition to droplets, contamination of surfaces, which are touched by people is one of the main ways that COVID-19 spreads.[8] It is therefore recommended that a shared use of objects is avoided, whenever possible. If it cannot be avoided, objects such as keyboards, telephones, desks, etc, should be wiped with disinfectant regularly.

  - If possible, people should not share workspaces or workstations unless there is a three-day interval in-between or the area has been cleaned (wiped down with disinfectant). A disinfectant spray should be used at the workstation to clean door handles, tables and common surfaces: this can be done at shift changes, e.g. the agents arriving on shift clean the common surfaces;
  - Avoid sharing common objects (no exchange of pens for example);
  - Persons should use their own IT equipment (keyboards, mice, touch screens, etc). Alternatively, a plastic film can be stretched on the computer keyboard and removed after a person finishes using it and the items, or cleaned, if possible, with a disinfectant or a suitable, non-contact cleaner. Some institutions mandate wearing gloves. In such a case, they should be changed often. Also, use of gloves should not be a substitute for good hand hygiene and general infection control;
  - The paper transmission notebook can be transformed into electronic transmissions.

- For food:
  - Avoid bringing and sharing food;
  - Do not make drinks for other people;
  - If you are preparing meals in the kitchen:
    - Wash hands before preparing food: 30 seconds including wrists;
    - Wearing a surgical mask during food preparation;
    - If raw food is purchased in plastic wrap, you can prepare it with gloves if necessary.

[8] https://apps.who.int/iris/bitstream/handle/10665/331705/WHO-2019-nCoV-Food_Safety-2020.1-eng.pdf