Construction Execution Plan
Lee Moor Project
IMERYS China Clay Works
Revision A, Date 20/05/2011

Project Name: Lee Moor Advanced AD Works
Direct Client: AAD (SW)
Owner (end user): AAD (SW)
Location: IMERYS China Clay Works

1.0 Project Details - Scope of Works:
Description/Overview

The multimillion pound EFW Project is to be constructed on the Lee Moor site. Lee Moor is a mothballed quarry site leased from Imerys Minerals Limited ("IML"), a wholly owned subsidiary of Imerys SA (Grid ref:SX 56380 61286, Lat 50433810 long -40236139). Moreover, the Lee Moor site is ideally located to benefit from ready access to an outlet for the digestate produced via the AD process. The site is adjoined by a second IML site, a quarry, which will be able to use the digestate for landscape restoration purposes. The waste will be supplied on-demand from a local waste transfer station which handles a predominately C&I based waste stream.

AeroThermal Autoclaves installed in the existing building will receive and treat the raw waste. The aim of the autoclave process is to 'cook' the waste using carefully controlled steam and pressure, before sorting the residual material through a series of screens and recovery systems. This hydrolysed material is sterile on exiting the autoclave and has been homogenised with a more open cell structure and broken-down lignin content. This allows it to be more amenable to the biodegradation process of anaerobic digestion, thereby producing more gas more quickly, generally with higher methane content. This increase in performance is further compounded by the autoclaves ability to unlock greater proportions of the organics, otherwise normally undigestable. Organic waste containing food must by law be either pasteurised, prior to anaerobic digestion (Reference - The Animal By-Products Regulations ABPR). These regulations require the processing of all food wastes to strict requirements designed to prevent future spread of infections which might otherwise survive waste processing methods such as Anaerobic Digestion to threaten re-infection of livestock. The processing temperature (160 degC for 45 mins)

Autoclaves will ensure that all the organic material is pasteurised prior to digestion. On exiting the autoclave, the clean ‘non-organic’ recyclable materials (incl. glass, plastics, textiles and metals) are automatically segregated into separate storage containers in order that they may be sold. The hydrolysed organic output from the autoclave process is diluted to produce a slurry with a dry solid content of approximately 10% for feeding to the anaerobic digestion tanks. A macerator pump used will be used to transfer the slurry into the aerated grit channel to assure that any rags or fibres are broken up.

After removal of grit and floating material the slurry will pass into a buffer sump prior to transfer into the AD tanks. The purpose of the anaerobic digestion tanks, (bioreactors), is to provide the optimum conditions for the AD process to occur i.e. in the absence of oxygen and at the correct temperature (37°C or 55°C). This process converts the organic matter into a stable product (digestate), and biogas, a mixture of approximately 60% methane and 40% carbon dioxide. The electricity generation plant is
then driven by a reciprocating engine powered by the methane gas produced as part of the anaerobic digestion process.

Due to the requirement to add additional water into the AD process to maximise hydrolysis, the plant has a significant water requirement. The majority of the required water can be recycled round the process, with any surplus requiring clean-up/treatment, following which it may be discharged to river under a whole site EA permit. There will be potential for odorous air to arise from the Waste Reception Hall, AD pumping sumps, the Dewatering plant and the Mechanical Separation Process. All potentially odorous air will be collected and contained and will be directed to a dedicated odour abatement system. Treated air emissions from the odour abatement system will be discharged to atmosphere through a dedicated stacks.

The construction will benefit from the utilisation and conversion of the existing assets. This will need to be managed.

The nine existing tanks will be modified to provide AD, storage and dewatering facilities. The existing building will be extended in order to house the imported waste handling, autoclaves and course screens installations.

Whilst the majority of services are redundant the potential working area will include a live a gas main, existing live Sub –station (including REC Grid connection) and underground cables.

There is also an existing outfall leading directly to the Wotter Brook.

The site entrance is on the corner of the B3417 and visible overhead lines exist. The existing assets will need to be surveyed and inspected to ensure fitness for the new purpose and avoidance any unscheduled work.

A survey has been conducted by IMERYS of the existing site. Naturally Occurring Radioactive Materials (NORM) is known to exist at the site. Pipe work identified as contaminated includes underflow from the tanks, inlet-outlets and the array running along the pathway to the east of the larger tanks. In addition, much of the pipe work surrounding the Screen House is affected by radioactive deposits. None is suitable for re-use and access and workings in certain areas will need to be carefully managed. These will be removed by IMERYS preconstruction, they will undertake site clearance and demolition as a planned sequenced operation. Reactive NORM procedures will be enforced to ensure that any remaining contamination is dealt with by controlled procedures under IMERYS directions.

Much of the new plant is available as a packaged and or containerised solution and this may have certain benefits in the construction phase. There are few bulk materials to export off site and vehicle movements for deliveries and import should be managed to prevent or mitigate any potential disruption to the residents.

It is anticipated that the project will commence on site early fourth quarter of 2011 and may extend to include two periods of winter working at the start and completion of the project. Lee Moor is in an exposed open area of the Dartmouth National Park region.

Main components of project

- Extension of main building to receive waste conveyance systems, Autoclave, Coarse Screening and main Motor control center (MCC)
- Installation of weigh bridge at adjacent main building
• Amendments to adjacent storage building to receive fine screening equipment and transfer pumps to AD plant
• Conversion and roofing of four tanks to advanced digestion process units with external recirculation pumps and insulated walls
• Conversion of tank to house the packaged dewatering plant and drying equipment
• Conversion of tank to house centrate treatment packaged plant
• Conversion of tank for centrate storage
• Roofing and routing of pipework to two tanks for emergency storage facility
• CHP package plant and steam generation equipment installation on existing hardstanding areas
• Provision of wash water booster system package plant
• Routing of transfer pipework on existing bridges and cradles
• Site wide cabling of power and control
• Installation of works offices and facilities on existing hard standing

Design responsibility.

The Works Information has been developed as a performance specification together with references to appropriate standards, specifications, drawings, schedules and data sheets together with references to appropriate regulations by ATGUK, required in order to meet the Employers objectives to the point where the appointed EPCC Contractor will undertake completing the detailed design and the completion of the works.

The design including Plant and Materials shall be fit for the purpose intended or implied within the contract. The works shall have a design life of 20 years to full replacement and 10 years to first refurbishment.

Identified dependent core technology

• Autoclave packaged plant
• Screening
• Combined Heat and Power (CHP) packaged plant
• Dewatering packaged plant
• Treatment packaged plant

2.0 Construction Methodology

Main features of the project (concrete structures, pipework, plant installation)

The only significant concrete structure will be the foundations to the extension of the main building. These have been designed to take into account as far as possible the existing contours, minimising the need for excavation and export of material. **APPENDIX B** Shows an indicative sequence and timing for these works. IMERYS will undertake a NORM contamination survey and clearance operation of the area prior to works commencing.

Excavation and profiling to formation will be undertaken using a 15 tonne excavator or similar. Formation will involve the deposition of some imported fill compacted with a tandem vibrating roller. The formation will then be blinded with 75mm of concrete to receive steel reinforcement, formwork and in situ placed structural concrete. Deposition of the in situ concrete will be undertaken using a 22m boom pump and hose. The concrete will be compacted using high frequency vibrating poker units. The sequence of construction will commence first with the toe beam, then slabs followed by rear walls and tie in to the existing building. Holding down bolts for the building superstructure will be cast into pockets in the slab ready for the erection of columns, beams and roof.

Prior to commencement of the erection of steelwork the area will be cleared of all other operations and demarcation and signing positioned to form an exclusion zone. Steel work erection will be completed using a combination of craneage (15t – 25t or similar) appropriate lifting situated on the slab and adjacent the extension to the building. During installation of the roof purlins etc the area will be netted. Cladding and sheeting will be installed using mobile elevated working platforms (MEWPS) and scissor lifts. The area around the extension will be cleared of all debris and a suitable formation will be provided for the plant at all times.

Following completion of the superstructure the extension and main building will be released for packaged plant, electrical works and miscellaneous metal work installation. The installation of the waste conveyance system, autoclaves, coarse screen and main MCC will be undertaken by preplanned operations. Delivery will be undertaken within normal working hours only. Plant used will be a combination of rollers, skids, craneage and frames.

Pipework installation is generally above ground using the existing bridge and cradles that exist on the works. This will be undertaken under a permit to impinge. This operation will be supported by local craneage (15t), and mobile elevated working platforms (MEWPs).

The area around the advanced digestion tanks and tank conversions will be cleared of existing pipework using a JCB excavator or similar and dumper, under control the NORM clearance procedures established with IMERYS. Localised installation of slabs and bunding will be undertaken assisted by JCB or similar, small hand tools, compressor and high frequency poker units for concrete compaction. In order to enable installation of circulation pumps to the advanced digestion tank subcontract specialist coring of the concrete will be undertaken. Puddle flanged circulation pipes will then be grouted into position using non shrink pourable cement based material.

Packaged plant installation within the tanks will be undertaken as a planned operation within normal hours using suitable adjacent craneage (25 – 40t all terrain type). Roofing will be undertaken by specialist subcontractors and the area will demarcated and zoned off to prevent entry during this period. Similar craneage to packaged plant installation will support these operations.
In addition, MEWPS and scissor lifts will be necessary to give access to tank walls during bolting and insulation operations. A clear, suitable formatted area will be installed around the tanks at all times.

Site wide installation of power and control cables will be installed generally above ground, and access will be facilitated by MEWPS and scissor type equipment. Working from ladders will not be permitted.

Conversion of the storage building to receive installation of the fine screen package plant and transfer pumps will be undertaken using a machine mounted percussion breaker, the extensive use of hand demolition compressive tools will be mitigated in order to prevent hazard arising from hand and arm vibration. Local construction of new walls and base amendments will be completed assisted by local craneage (15t) or similar, small hand tools, compressor and high frequency poker units for concrete compaction.

Miscellaneous paths and edgings will be completed using JCB type excavator, plate compactors, small tools, and dumper.

All portable plant will be placed on bunded drip trays to prevent leakage and spillage. A suitable emergency absorbent spill kit will be available on site at all times.

Water for testing purposes will be reused where possible and if necessary disposed of with prior discussion and permitting of the local Environmental Agency office.

Dealing with technical construction issues

Existing service drawings and hazards have been identified as far as possible with data and drawings from IMERYS. A focus of the design team has been to route where possible, Pipework on existing above ground cradles. Therefore the construction will be undertaken utilising the assets of the existing works and with minimal excavation. Where excavation is necessary, trial excavations to determine the location and extent of the existing site services shall be completed sufficiently in advance to allow for any necessary adjustments to the design to be undertaken without adversely affecting the programme and mitigating the potential hazard from breakages. Appropriate Spill kits and will be readily available at all times on the site.

During the erection of steelwork to the main building netting will be installed and operations in the area will be limited only to those necessary the erection of steel work. A no entry demarcated area will be maintained until completion of this activity.

Dealing with restraints (keeping existing plant in operation, limited shut-down time, environmentally sensitive area etc.)

The only operation existing plant is the IMERYS HV building, Generators and Laboratory. These have been segregated outside the lease area and have no significant interface with the construction of the new works. IMERYS permitting procedures will apply in these areas.

The construction works will be undertaken without planned out of hours working – unless exceptional circumstances dictate otherwise. The general site hours will be 7am to 6pm Monday to Friday and 8am to 1pm Saturday.

Dealing with hazards (environmental, chemical, electrical, confined spaces, asbestos etc.)
Historic information, surveys and drawings have been obtained from IMERYS Environmental management System. These include:

- NORM Survey
- Asbestos Survey
- Chemical and Hazard plan
- Services location

These will be included in the pre construction file and managed in accordance with the CDM regulations. A proactive management system will be maintained in order to continuously monitor, review and plan for mitigation of potential hazards.

3.0 Contracting Method and Scope

The project will be awarded to an EPCC Principal contractor under the ECC Conditions of Contract Option C.

3.1 Local Subcontractors – the following works are planned to be subcontracted to local area subcontractors where possible:

- Formwork
- Concrete
- Steelfixing
- Cabling installation
- Miscellaneous metal work
- General labour
- Small plant items
- Plant hire
- General construction materials
- Oils and construction consumables
- Catering

3.2 Subcontractors – the following works are planned to be subcontracted to subcontractors.

- MCC and Control integration works
- Packaged plant, design, offsite manufacture, installation and commissioning
- Membrane roofs

3.3 Construction scope:

The EPCC Principal Contractor will be engaged to engineer, procure, construction and commission of the works in accordance with the Works Information.

3.4 Procurement Strategy:

*Strategy, programme, resource allocation*

The majority of the major plant items will be procured as package plant. This will maximise off site construction and minimize transport and installation times. All deliveries will be by planned events occurring within normal working hours.
Initial work in developing a comprehensive design and robust programme, aided by the early
involvement of critical specialist subcontract partners, will ensure that long ‘lead in’ items are readily
identified and programmed accordingly.

The programme will be monitored, reviewed and updated throughout the design and construction
period in line with the ECC Form of Contract. It will identify the critical path and key activities with the
greatest risk on an on-going basis, thus ensuring that issues are identified at the earliest stages and
mitigation measures established well in advance of the works being carried out.

Adoption of these measures will guarantee the timely handover of the plant in accordance with
AAD’s requirements whilst mitigating potential local disruption.

4.0 Project Milestone Schedule
Completion dates, Project completion terms - Predecessors, permissives and triggers.

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<td>Planning and permits – Contract award</td>
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<td>Project Construction Start</td>
<td>4th quarter 2011</td>
<td>Mobilise and implement QMS site specific systems</td>
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<td>1st quarter 2013</td>
<td>Wet commissioning and plant start up</td>
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<td>Digester maturity and CHP, odour plant, and treatment optimisation and commissioning</td>
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<td>Completion of plant trials and startup</td>
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5.0 Construction Sequence and Execution
Outline of the Project and Construction Execution Plan (e.g. bar chart)

See APPENDIX C for Construction Overview
6.0 Management Personnel Staffing Plan (Construction Phase)
The proposed Project Organization Chart, indicating both company (AAD (SW) and Principal Contractor / subcontractor) and key site personnel tentative assignments (where possible) assigned.
7.0 Construction Site Office Requirements
No of occupants, floor area, materials of construction, facilities, services, communications, parking, design office, meeting rooms

Site welfare facilities will be installed on the elevated existing hard standing. It is intended that these units will be double stacked and comprise of superior quality Portakabin type accommodation Units. The lower cabins will be sized and situated to enable their future use as the main offices and messing facilities for the operation staff of the works. Parking will be provided at the front of the office complex with demarcated overflow facility at the lower level hardstanding area. A pedestrian vehicle segregation plan will be developed and signed on the site. This will also be communicated through inductions. This plan will be systematically reviewed and remain live through the construction period.

Prior to completion of the office and welfare facilities a temporary portaloo type and drying, mess and washing facilities will be made available.

A controlled signing in and induction procedure will be maintained for all staff and visitors throughout the construction and operation phases.

Indicative elevation Layout – Construction Phase

Indicative elevation Layout – Operational works Phase
8.0 Construction Facilities Requirements

*Labour facilities, Client accommodation, fabrication yards, testing facilities, warehousing etc.*

Dedicated messing, drying, toilets and shower facilities will be supplied for the labour force. Client accommodation will be allocated 2 x offices and all other facilities will be shared.

A dedicated material lay down area, storage compound and quarantine area for deliveries will be maintained in a fenced controlled area at the compound to the west of the site.

9.0 Construction utilities and services requirements

*Water supply, power supply, on-site generation, waste disposal etc.*

Telecom and potable water connections will routed to the cabins by prior discussion and arrangement with the statutory authorities. These services are known to exist in the adjacent Laboratory.

A proprietary waste water holding tank facility will be installed for offsite tankering and disposal. It will be necessary to use a packaged generator complete with double skinned and bunded tank adjacent the offices prior to mains connection at a later date.

10.0 Construction site conditions

*General site access needs, access and exit restraints, site security, land contamination, hazardous materials, swampy areas, existing structures, public access through the site, adjacent road or rail, overhead cables, etc.*

Access to site will be by the main entrance and will be managed from the main offices situated adjacent the entrance. All deliveries will be planned ahead and suppliers notified of routing and sign in procedures. Public access will not be prevented. Site security will be managed by existing cameras and these will be extended as necessary. The works area will be fenced. Animals will be prevented from straying onto the site.

Overhead cable hazards will be mitigated in accordance with HSE Guidance Note GS6.
Potentially hazardous materials will be managed in accordance with COSHH regulations and stored as appropriate within the compound area.

The existing works forming the redundant China Clay plant will be fenced off from the new project works to prevent access.

### 11.0 Construction skills requirements

*Brief description of estimated personnel requirements and peak loading [Staffing Plan]*

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Estimated personnel requirements – Construction Phase

Peak loading – Construction Phase

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Estimated personnel requirements – Operational Phase

### 12.0 Construction equipment and specialist tools requirements

*List of Major construction/installation equipment and any specialist tools, giving description, make (model) and quantity. Shown in APPENDIX A*

### 13.0 Construction Site Rules

*Working permits, CSCS cards, health cards etc.*

Systems will include, but not limited to the following;

- Construction skills certification or equivalent monitoring undertaken prior to engagement of labour and subcontractors
- Specific site safety rules
• Toolbox talks
• Specific site Inductions
• Permitting and control of critical areas in accordance with management system
• Health surveillance implementation
• Drugs and alcohol policy implementation

14.0 Construction Loss Management (Health & Safety)

Observing current CDM regulations, establish sub-contractor responsibilities, client H&S requirements, site provision of full time safety cover

The Employer has appointed ATG as the CDM co-ordinator for the project. The Contractor will be appointed to act as the “Principal Contractor”. The Contractor shall also be a Designer within the terms of the CDM Regulations.

The Contractor shall develop in consultation with others the Pre-Tender Health and Safety Plan into a suitably developed Construction Phase Health & Safety Plan, prior to commencing work on Site.

The Contractor shall prepare risk assessments and method statements.

The Contractor shall obtain from other contractors engaged to work on the project details of their risk assessments and details of how they intend to manage risk.

The Contractor shall provide to the CDM co-ordinator any information that they have, or can readily obtain, which is needed for inclusion in the health and safety file.

The Contractor shall monitor the health and safety performance of persons and companies working on the project.

The Contractor shall ensure that the design (drawings and specifications, etc.) contains information about any aspect or material that might adversely affect the health or safety of anyone working on the project.

The Contractor shall manage all risks that cannot be avoided in the design.

The Contractor is responsible for induction of his own staff, his sub-contractors and suppliers, providing information to ensure all his health and safety obligations are met.

The Contractor shall hold Safety Reviews at agreed intervals.

In addition to his statutory obligations, the Contractor shall be guided by the recommendations in “Construction Safety” published by Construction Industry publications Ltd; ISBN Code 185263 002 7 and also by (but not limited to):

• Health & Safety Management Manual
• Authorised Permit to Work System
• Safe Working Procedures Manual
• Emergency procedures
• Electrical Safety Procedures
• Access Permit / Site Induction Procedure

The Contractor shall prepare an Explosive Atmosphere Risk Assessment in accordance with Engineering Specifications
Method statements shall indicate the standards, codes of practice, principal materials and methodology to be used to design each element of the works. All the assumptions to be made shall be identified and justified.

Leptospirosis (Weil's Disease) is an infection transmitted to humans by contact with urine from infected rats. Work in or about water such as rivers or canals carries a high risk. The Contractor shall ensure that all persons employed on the works are made aware of Weil's Disease by issue and/or posting of Health and Safety executive information on the subject.

The Employer shall conduct reviews at the start and upon completion of the works. The Contractor shall ensure that any resulting actions are undertaken and closed out.

15.0 Construction Quality and Testing
Construction will be undertaken in accordance with the AAD (SW) EPCC Contractor’s quality systems. Where there are special conditions imposed on the EPCC within the contract, for example: the application of IMERYS imposed systems, these shall be stated in the Contract. For example impinge notifications and permits to access HV building etc.

The AAD (SW) appointed EPCC Contractor will have Certification to the following standards and management systems or equivalent;

- Safety Certification. BS OHSAS 18001
- Environmental Certification BS EN ISO 14001
- Quality Certification BS EN ISO 9001

Quality Control Plan: programme, procedures, staffing, resources

Inspection
Full access to the Contractors, Subcontractors or supplier’s works shall be provided for inspection at any stage of the construction programme. The Project Manger shall give five days notice for such an inspection at the Contractors, Subcontractors or supplier’s works

Factory Acceptance Tests
Factory acceptance tests shall demonstrate that the Plant and Materials will provide the required functionality and operation specified whilst meeting the performance or acceptance criteria as defined in the Works Information. The Contractor shall not dismantle and deliver any Plant and Materials to site until the factory acceptance tests are complete and signed-off to the satisfaction of the Employer or their appointed representative. On completion of a satisfactory factory acceptance test, the Contractor shall submit a test report detailing the findings of the tests and shall including original test data and signed-off test sheets which shall be integrated into the commissioning plan along with the test procedure.

Site Acceptance Tests
Site acceptance tests shall be carried out following satisfactory completion of installation and inspection of the works. Site acceptance tests shall be carried out on all Plant and Materials, including software and systems, and with all third party systems to which the works interfaces.

The site acceptance tests shall typically include:
- Pre-Commissioning Checks performed on completion of construction and before Plant is 'energised' for the first time
- Functional Tests with Plant 'energised', to prove the performance of units, subsystems and systems achieve the full design criteria as defined in the Works Information.
• Full Process commissioning to ensure that the works can be operated to give the intended performance
• Software and PLC Site Acceptance Tests
• Functional I/O testing of all MCC Plant, with associated starters being configured in ‘TEST’ mode. These tests shall be carried out in conjunction with the MCC suppliers/installers
• Functional I/O testing of all field equipment and instrumentation
• Performance testing of the completed PLC, HMI and any telemetry interfaces to demonstrate the performance required by the Works Information

Site acceptance tests shall be documented in a test procedure which shall be submitted to the Project Manager for acceptance prior to commencement of the tests. On completion of testing the Contractor shall submit a test report detailing the findings of the test including original test data and signed-off test sheets which shall be integrated into the commissioning plan along with the test procedure.

A quarantine area for any materials and plant that have been delivered that are non compliant will be maintained in the compound area.

16.0 Constructability Review

A constructability review will be carried out ahead of build, regardless of design responsibility of the partners, to avoid problems during construction. This will be facilitated and actions arising will be captured and managed.

17.0 Commissioning & Startup Support

What commissioning, performance and start-up requirements must be met before completion certificate is issued? Commissioning Plan: programme, procedures, staffing, resources

Prior to the commencement of commissioning the EPCC will prepare an integrated commissioning plan. The plan will clearly identify interfaces, responsibilities, dependencies, modus operandi and an overall programme.

Weekly commissioning meetings will be held where the two week look-ahead plan is updated and works for the forthcoming week are coordinated.

The hardwired and software interlock between systems will be fully tested. Then the plant will be run in a dry state and all functions/sequences will be tested.

The Principal Contractor we will control all permits and ensure method statements and risk assessments are in place for each commissioning activity.
- Commissioning
  - IO testing
  - Dry Test
  - Wet Test
  - Take Waste
  - Process Commission
  - Digester Maturity
  - Ph2 Commission Gas engines
- Handover
  - O&M Documentation
  - Training
  - Completion
  - Optimise
  - Support
  - Start Performance Test
### APPENDIX A – CONSTRUCTION PLANT

#### AAD (SW) – LEE MOOR ADD/2 – Plant forecast

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### Lee Moor - Construction Execution Plan

**Lee Moor**

**Date:** May 2011

#### Table 1: AAD (SW) - Lee Moor ADD12 - Contract - Plant Forecast

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## APPENDIX B – MAIN BUILDING CONSTRUCTION

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![Gantt Chart](image-url)
APPENDIX C – CONSTRUCTION OVERVIEW

SEE Attached PDF file LM Build.pdf for Detailed view.