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Assembling, Integration, commissioning, and delivery of the ALMA Hardware in the Loop Simulation Environment

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The Atacama Large Millimeter/submillimeter Array (ALMA) telescope has been working in the operations regime since 2013. After almost 10 years of successful operation, the obsolescence of hardware and software emerged. On other hand, the ALMA 2030 plan will add new disrupting capabilities to the ALMA telescope. Both efforts require an increased amount of technical time and instrument resources for validation and testing in order to minimize the risks to introduce instability in the operations when new equipment and software is integrated into the telescope. Therefore, the process of designing, building, testing, and commissioning a new simulation environment, which must be comparable to the production environment, was started in 2017, passed the Critical Design and Manufacturing Review (CDMR) in 2020, was built and commissioned in 2021, and was accepted as a new ALMA Telescope sub-system in 2022. In this paper, the details and of this project are reviewed focusing on the assembling, integration, and commissioning processes, in addition, a description of the use cases where this new facility has proven its valuable contribution is presented.
Data from the observations conducted to validate this new test environment are presented, and the obtained results are analyzed and discussed establishing a relation between the obtained results, and the specific feature under test. In addition, preliminary metrics of the gained time for science operations are presented.
Special attention is given to the scalability of the features to be exercised, highlighting the limitations and describing possibilities to overcome the constraints imposed by the reduced size of this instrument.
A description of the test environment operation is given, remarking on aspects like logistics, and technical support and stressing the strategies for sharing resources between the ALMA telescope and the simulation environment.

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