

Connor Daniel (1909665)

project proposal

by Connor Daniel

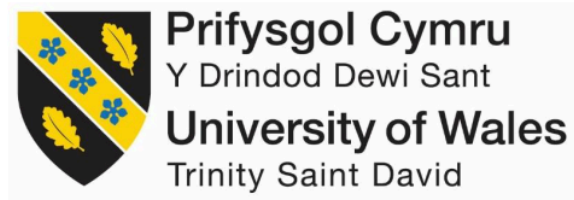
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Improving the wash equipment and procedure in a CMF to better comply with GMP standards

By
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2nd choice Stephen Mosey

Project proposal submitted as part of the requirements
for the award of

BEng (Hons) Electrical and Electronics Engineering

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Introduction

This project will look to identify the issues that are present with the current parts washer procedure and equipment set up that is in place at PCI Pharma Services. Throughout this project different options will be analysed against data and design to see which solution best fits the needs of the engineers and operator once the system has been put in place.

Due to the company making highly potent drugs used to treat oncology patients, after each batch has been manufactured the equipment needs to be cleaned. The current procedure in place requires both an operator and an engineer each time a change of detergent is required on the parts washer. This can take up a lot of the engineers' time and can result in downtime for the parts washer if there is a breakdown or maintenance is being completed on another machine as manufacturing will take priority. This can lead to manufacturing being pushed back due to equipment not being clean on time.

The current equipment in place has one line which is used for five different types of detergents and for the water that is used to flush the system before priming. This means the engineer must swap the line over to first flush the line with water and then into the detergent to prime the line. The engineer then must go to the facility to provide the operator with the detergent information such as lot number and expiry date before signing a record book to comply with Good Manufacturing Practice (GMP) standards, as the engineer is the person who changed the detergent. This procedure and the fact that there is only one line is also causing issues with cross contamination between the detergents and the water used to flush the system as the same line is being used.

The aim of this project is to make the parts washer a more efficient and cleaner process in the hope it will reduce downtime, reduce the engineers' workload and remove cross contamination. These three factors will be the measurable aspects that will determine whether the project has been a success.

Background to the project

GMP standards and validation

Due to the project being undertaken in the pharmaceutical industry, there are many standards that this project will need to comply with. This is especially important when it comes to this project as the aim is to improve the cleaning procedure of equipment where the active ingredients are highly potent. According to source [1] the Good Manufacturing Practice rules state “The sites and equipment must be situated, designed, created, adapted and maintained to comply with the operations which must be performed. Their position and design must reduce to a minimum level the risks of errors and must allow an efficient cleaning and maintenance to avoid the cross contamination, the deposits of dust or dirt and, generally, any unwanted effect on the products’ quality.” This must be considered throughout the project as this will have a big impact on whether the project will pass the validation stage.

As previously stated for the project to be a success and for it to be implemented within the workplace, it will have to pass the cleaning validation process. This means that equipment should not only be clean to prevent cross contamination but also for the operator to safely work on the equipment. Source [2] states that “Equipment and utensils shall be cleaned, maintained, and sanitized at appropriate intervals to prevent malfunctions or contamination that would alter the safety, identity, strength, quality, or purity of the drug product beyond the official or other established requirements”. It also states that “Patients shall not be exposed to more than 1/1000 of the therapeutic dose of another API (as carry over residue)”. To ensure that these requirements are met the project will use the method of having a final rinse of purified water and testing for the conductivity levels left in the purified using a conductivity sensor, this is a method also backed by source [2]. The next stage for this project to pass validation is to correspond the microbiology department and have them swab the equipment after it has come out of the parts washer to ensure there is no residue left behind. This will confirm that the changes made to the system have had no effect on the quality of the wash.

Existing systems

According to source [3] there are currently 3 main types of cleaning systems used in the pharmaceutical industry. These are Clean-In-Place (CIP), Sterilize-In-Place (SIP) and Clean-Out-Of-Place (COP).

Clean-In-Place (CIP)

A clean in place system is one that can be used in situ or is portable and can be transferred from one vessel to another. Clean in place systems vary in complexity from basic manual to complex system. A simple system will consist of a pump usually a double diaphragm or centrifugal, a positioning device which is typically a simple piece of pipe with connections fitted and the cleaning heads which spray the solution and are either twin or single axis, fixed or rotating. CIP systems can also be more complex introducing an automatic or semi-automatic system. This will use a PLC or manually selected program to complete the wash, selecting the type of equipment being washed, hot or cold water and the detergent needing to be added. The program will typically display other information such as pressure and flow rate. [3]

Sterilize-In-Place (SIP)

This type of system is normally integrated into a CIP program where sterilization is used to remove any remaining bacteria from the equipment. It uses heat normally in the form of steam for a set period to do this. [3]

Clean-Out-Of-Place (COP)

Clean-Out-Of-Place systems are used for equipment that can be dismantled and transported. The system will consist of a bay that is enclosed and is fitted with the parts needed to complete the wash. The systems are fitted with steam, water and detergent lines, drains and spray arms. They can be operated from an HMI with set recipes for the operator to select and run. The operator can also complete manual task from the HMI as flushing the lines with water and priming the lines with the detergent needed which is essential before beginning a wash recipe. [3]

Product design

Current system

As stated previously the current system in place only consists of only one line for shared between the water for flushing and all other detergents, this is causing many issues and needs to be improved on. The current system looks as shown below:



Figure 1

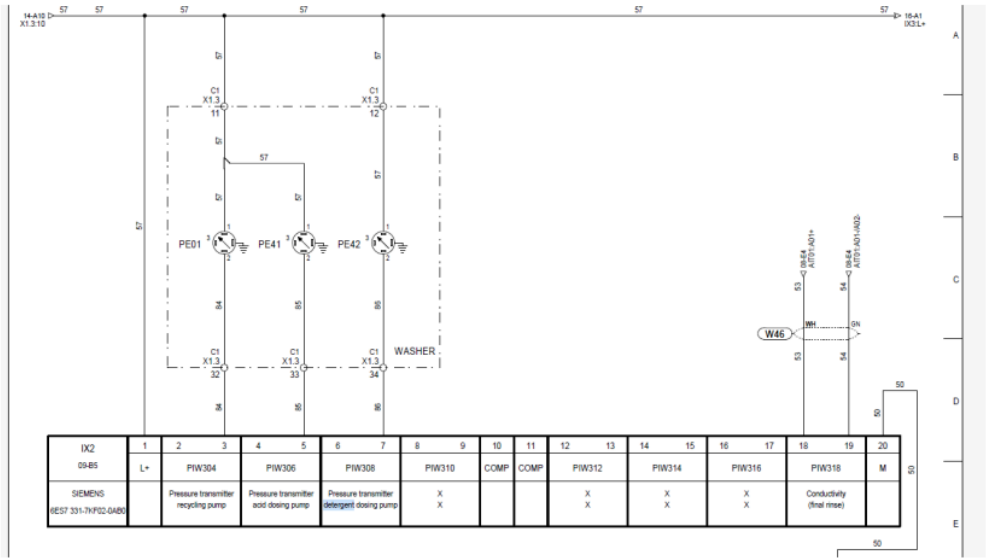


Figure 2

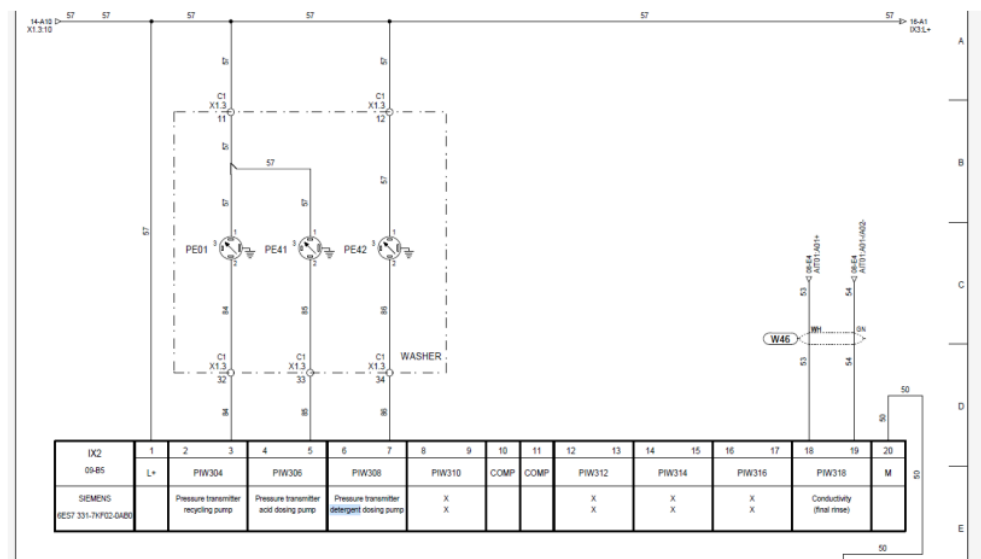


Figure 3

3. CHEMICALS PUMPS PRIMING

☐ Main Menu ☐ System menu ☐ Service → Pump priming

This menu is used to prime the dosing pump after chemical tank change to avoid air in the pipe.

It can also be used to measure the pump flow rate.

CHEMICALS PUMPS PRIMING

Choose the additive to be activated. Test period (60s). Afterwards, do not forget to fill and drain the chamber to rinse it.

Acid pressure mbars

Detergent pressure mbars

Pump priming timer s

EXIT Detergent Acid Filling Draining

Stopped

ADDITIVES PRIMING

Choose the additive to be activated. Test period (60s). Afterwards, do not forget to fill and drain the chamber to rinse it.

ADDITIVE 1 PRIMING IN PROGRESS

Additive 1 pressure mbars

Additive 2 pressure mbars

Timer s

STOP

Running

Figure 4

As shown from the figures 1 and 2 above the current system only has one detergent line that is used for five different types of detergents and the water flush for the lines. This system is

creating the need for an engineer every time a different detergent is being used causing downtime on other machinery and the parts washer itself. There is also an issue of cross contamination due to the same line being used for all washes. The new system will look to implement a line for each individual detergent and the water used for flushing the system. The individual lines will then be connected to a manifold which will be fitted with solenoids for each line. The selected solenoid will open and allow the correct detergent to flow through. The manifold will have a line coming out the opposite side which will pull the detergent through and into the parts washer chamber. This new system will remove the need to call an engineer resulting in less downtime and remove the issue of cross contamination.

Another issue with the current system is there is no indication to the operator of how much detergent is left in the tank. The only indication the operator receives is when the tank is empty which is shown through a low pressure using a pressure transmitter seen in figure 3. The new system will remove this issue using a float switch connected to each line, this will be integrated into the HMI showing the operator both a visual representation and the capacity remaining in litres. This will inform the operator before starting that a new tank of detergent is needed prior to the wash.

The current HMI set up is shown in figure 4 the operator currently only has the option to start the detergent pump and view the pressure. The issue with this is it provides no information to operator that they will need to record for GMP, meaning an engineer would still be required to go and gather the information. The new system will provide these details such as detergent expiry date and lot number on the HMI and will be inputted when a new tank is used. Allowing the operator to take the information of the HMI to complete the necessary paperwork. The new HMI will allow the operator to select which detergent they want to use instead of starting the pump, each detergent will have its own code to open the solenoid and pump the detergent.

New system
System concept

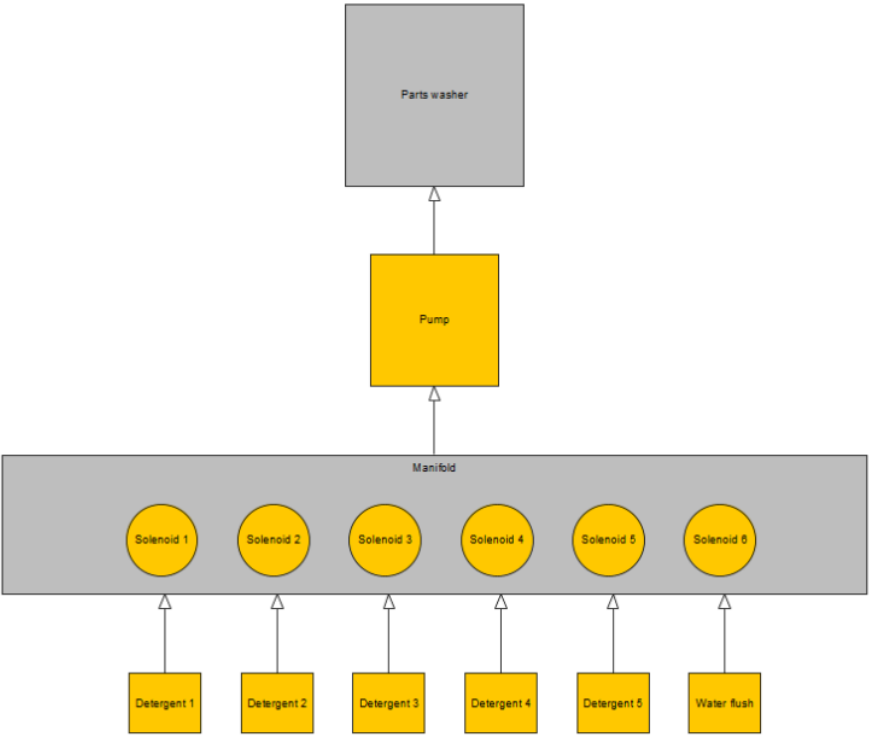


Figure 5

HMI concept

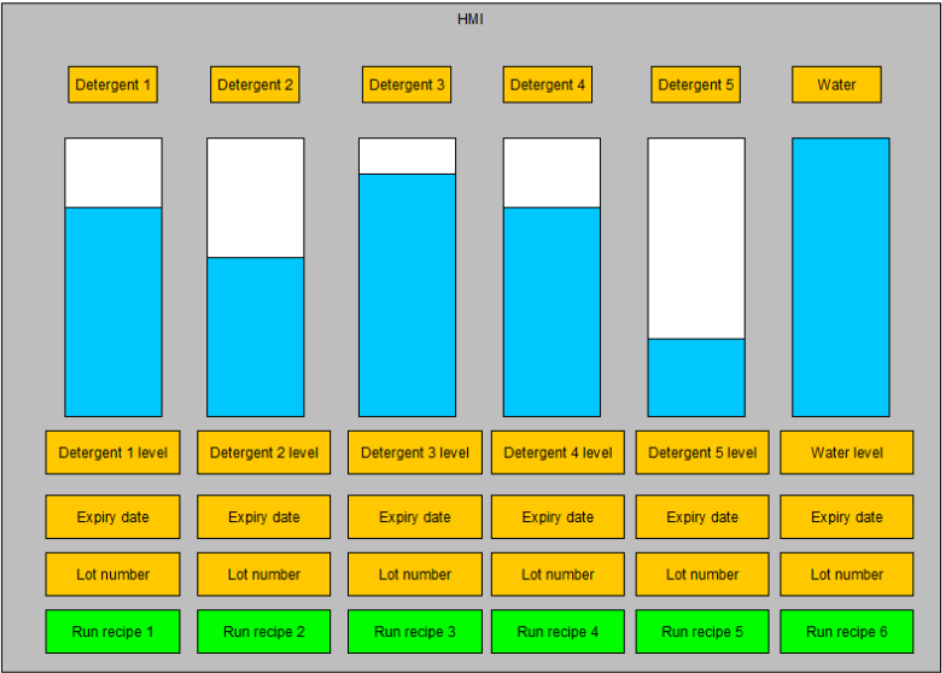


Figure 6

Resources and planning

Hardware	Software
Detergent jacks	Siemens TIA portal
Manifold	Factory IO
Solenoids	yEd
Pump	Microsoft office
Parts washer	
PLC	
HMI	
Detergent lines	
Float switches	
Electrical cable	
Cable ferrule	
Jubilee clips	
Cable ties	
Heat gun	
Heat shrink sleeving for detergent lines	
Labelling machine	
Cable identification tags	
General tools	

Figure 7

Deliverables
1. Two prototypes will be created first a simulation using Siemens TIA Portal and factory IO to simulate how the system should work. The second will be created in the workshop for proof of concept before installing the final system to the parts washer.
2. A graph will be provided comparing the number of instances an engineer was called prior to and after the new system was installed.
3. A graph will be provided to compare the amount of downtime the parts washer was receiving prior to and after the new system was installed.
4. Test results from the swabbing team to prove the system passes swabbing test and does not impact the effectiveness of the system.
5. A questionnaire from the operators of the parts washer providing information on if the new system has improved the procedure and is easier to use when compared to the old system.

Figure 8

Gantt chart		
Task	Start date	Days to complete
Formulating ideas with work place	1 October 2024	7
Completing research on chosen topic	7 October 2024	14
Designing first draft concepts	21 October 2024	3
Completing ethics form	23 October 2024	2
Creating proposal gantt chart	25 October 2024	2
Working on project proposal	7 October 2024	21
Working on final report	29 October 2024	183
Researching components for physical prototype	29 October 2024	28
Working on simulation prototype	14 November 2024	28
Ordering parts for physical prototype and waiting for delivery	13 December 2024	7
Christmas break	21 December 2024	12
Working on interim viva	2 January 2025	15
Working on physical prototype	6 January 2025	21
Installing pump system to the machine	28 January 2025	21
Testing, validation and system approval	19 February 2025	42
Working on final viva	2 April 2025	28
Working on project poster	16 April 2025	23
Project questionnaire	2 May 2025	7

Figure 9

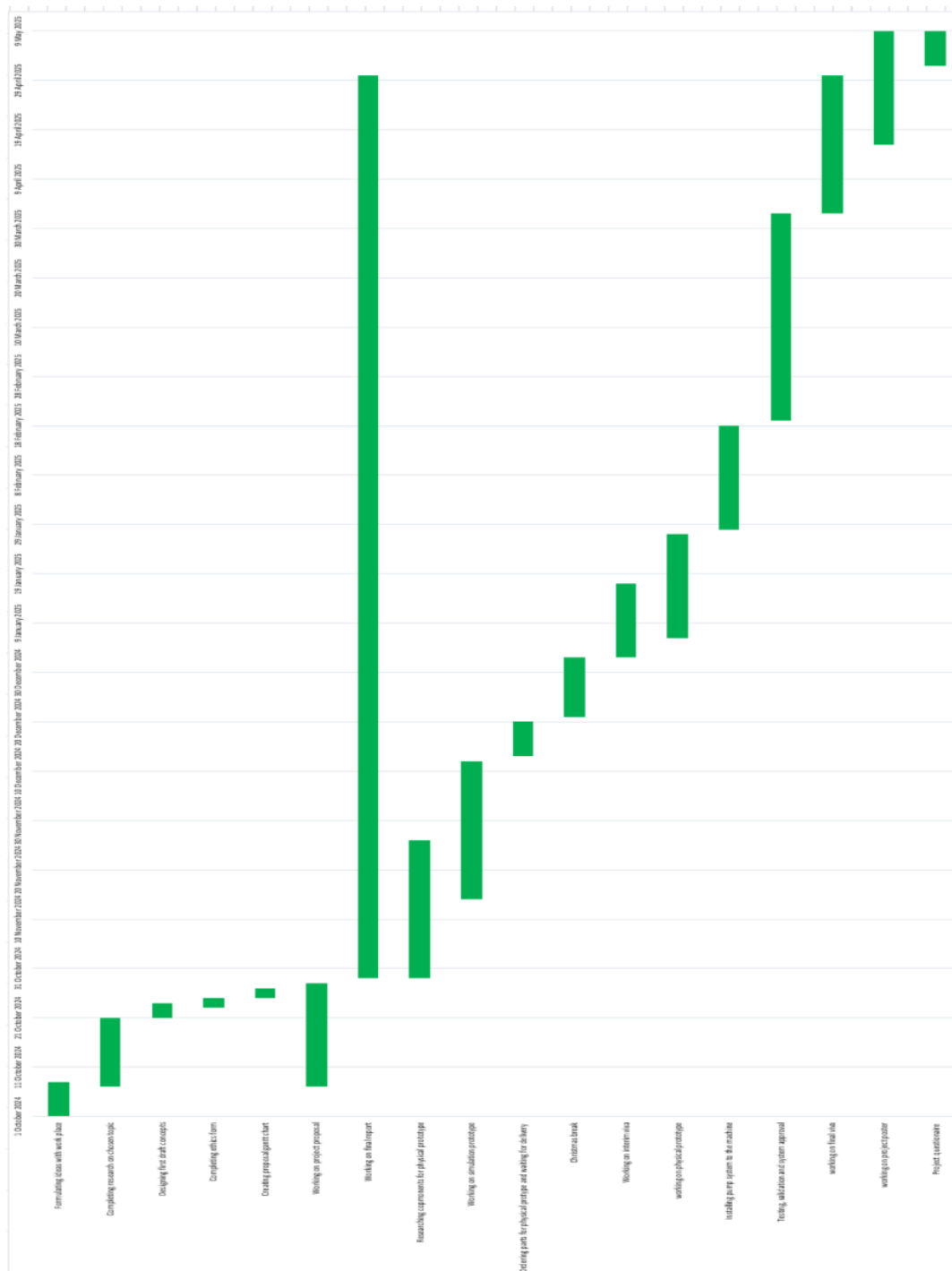


Figure 10

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GRADEMARK REPORT

FINAL GRADE

GENERAL COMMENTS

76/100

Module Code/ Module Name	ACCA6020 / INDEPENDENT PROJECT		
Student Name	Connor Daniel		
Student Number	1909665		
PROJECT PROPOSAL FEEDBACK			
Introduction / A&O: Project title; Identification of a specific problem to be investigated; Well-defined aims and SMART objectives; Explaining why this project is worth doing; Discussion of what the project needs to do in order to be a success; Description any deliverables that will be produced at the end of the project.	Max. Marks	Marks Obtained	
The project title is clear and aligns with the objective but it would be better if it is slightly shortened. The problem identification is good. The aims of the project is well-defined it would have been better if the objectives were clearly listed and written in SMART term. The rationale is clear and provides	20	17	

a valid justification for the work. The deliverables are mentioned.		
Background to the Project / Literature Review: Description of how the work to be done by in the project relates to the work identified in the literature review; Discussion of any ethical issues raised by the project Identifying what has already been done within the field; Topic familiarity; Brief literature review using appropriate sources – 6-8 journal papers and book chapters rather than just websites; Selection of relevant models & concepts	20	14
The background demonstrates a strong understanding of the problem. Ethical considerations are mentioned, particularly compliance with regulations. The review identifies general advances in industrial processes. Use of more peer reviewed research article would have strengthen the document. The report could include a brief comparison of alternative models or methods to provide a broader perspective.		
Project Design: Clear statement of which development methods are to be used and why they are appropriate; Clear statement of which tools are to be used and why they are	30	23

appropriate; Clear description of how data collected will be analysed.		
The development methods and tools are described well. The method is appropriate and aligns well with pharmaceutical standards However, A brief explanation of why this approach is chosen over other alternatives others could have been better. How data will be collected and analysed is mentioned.		
Resources / Planning: List of any deliverables; Clear diagram showing both timing and resource use; Completed ethics form; Limited and relevant appendices.	15	12
Good clear Gantt chart showing each tasks to be completed. Ethics form completed. Deliverables listed.		
Document Presentation: Correct spelling, grammar and punctuation; Flow of narrative/fluency; Coherence; Word processed ; Correct use of referencing with bibliography; Strict word limit	15	10
The document is well structured and well-presented with good spelling, grammar, and flow. Greater inclusion of peer-reviewed journals or authoritative books would enhance the quality of the references. Additionally, providing captions		

for each figure would improve the quality of the document. A thorough proofreading would polish the text.		
TOTAL	100	76

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