



## Dissemination workshop: Key elements for the new solar thermal energy plants

# SOLAR FIELD PREHEATING SYSTEM & DRAINAGE SYSTEM

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MSLOOP dissemination workshop  
Madrid, 9th of July 2019



"This project has received funding from the European Commission for Research and Innovation under grant agreement No 730609".



**INTRODUCTION**

**SOLAR FIELD PREHEATING SYSTEM**

**SOLAR FIELD PREHEATING SYSTEM – MSLOOP / COMMERCIAL SCALE**

**SOLAR FIELD PREHEATING SYSTEM – MSLOOP TESTS**

**DRAINAGE SYSTEM**



# INTRODUCTION

## WHO IS CADE?

- ✓ Since 2003, 45 employees



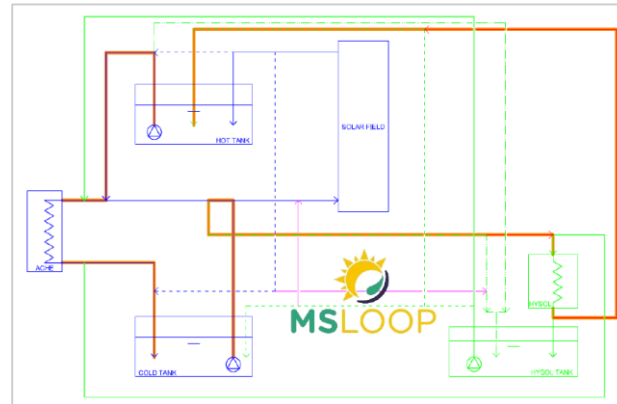
- ✓ From tech origin, > 900 MW served



- ✓ Molten salt loop prototype **DETAIL ENGINEERING**

## CADE IN MSLOOP 2.0

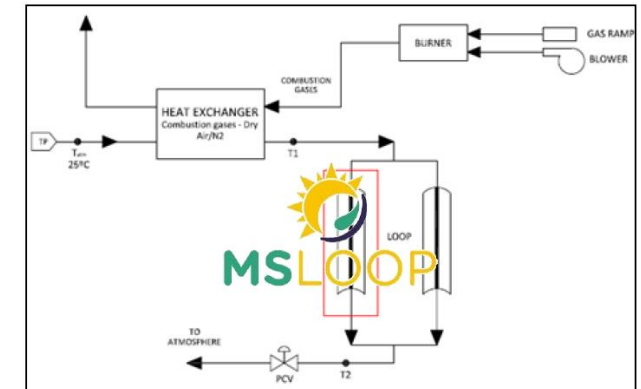
- ✓ MSLOOP OPERATIONAL CONDITIONS / STRATEGIES



- ✓ DRAINAGE TEST SYSTEM



- ✓ SOLAR FIELD PREHEATING SYSTEM



- ✓ DETAILED ENGINEERING
- ✓ TEST AND VALIDATION
- ✓ COMMERCIAL SCALING-UP OF MAIN SYSTEMS





# SOLAR FIELD PREHEATING SYSTEM

In CSP plants with thermal oil:  
PARCIAL FOLLOW METHOD

SOLAR FIELD HEATING BEFORE HIGHT TEMP. MOLTEN SALTS (MS) INLET:



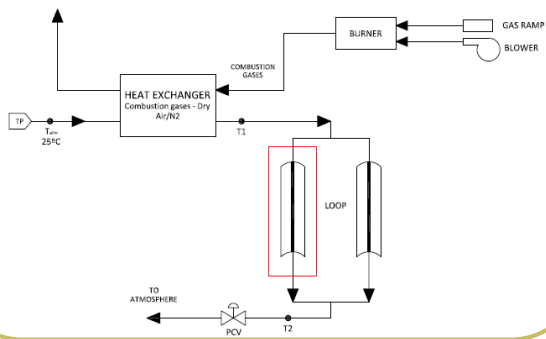
THERMAL SHOCK

MS FREEZING

## SYSTEM DESIGN BASIS

- ✓ HEATING MEDIUM → HOT & COMPRESSED GAS
- ✓ NITROGEN → INERT GAS (NOT MS DEGRADATION)
- ✓ SYSTEM CONFIGURATIONS

### OPEN PREHEATING SYSTEM



### CLOSED PREHEATING SYSTEM

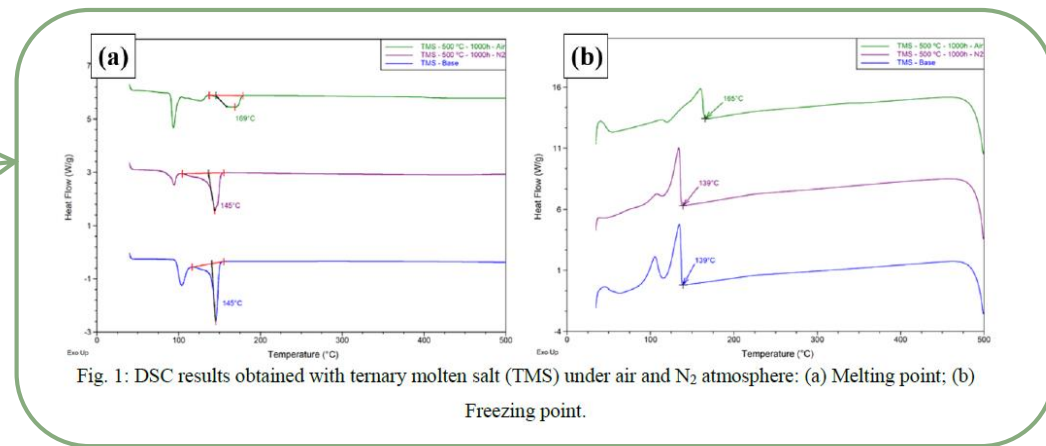
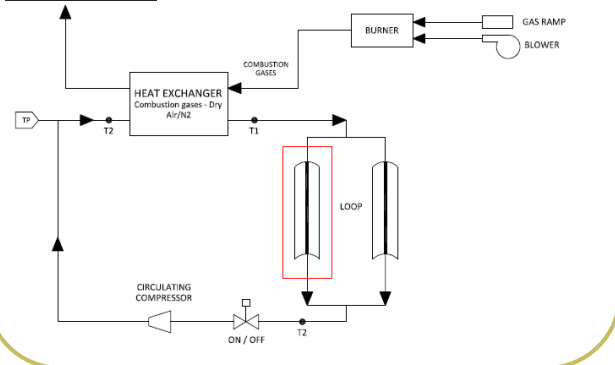
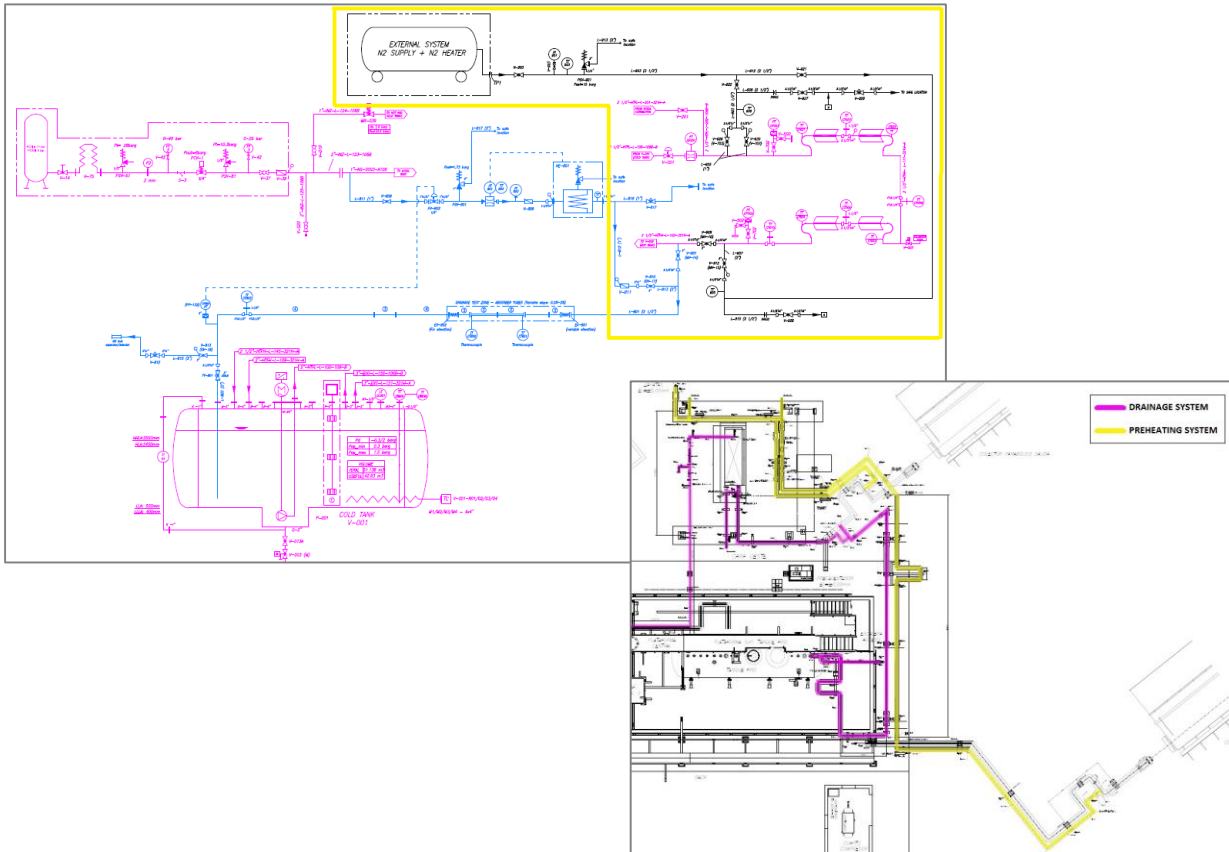


Fig. 1: DSC results obtained with ternary molten salt (TMS) under air and N<sub>2</sub> atmosphere: (a) Melting point; (b) Freezing point.

## MSLOOP PREHEATING SYSTEM

### OPEN PREHEATING SYSTEM



## COMMERCIAL SCALE PREHEATING SYSTEM

### CLOSED PREHEATING SYSTEM

- ↓ NITROGEN CONSUMPTION
- ↓ NATURAL GAS CONSUMPTION
- ↓ ELECTRICAL CONSUMPTION
- ↓ EQUIPMENT SIZE

↑ ENERGY EFFICIENCY



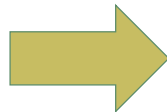
Energy Saving with CLOSED SYSTEM vs OPEN SYSTEM



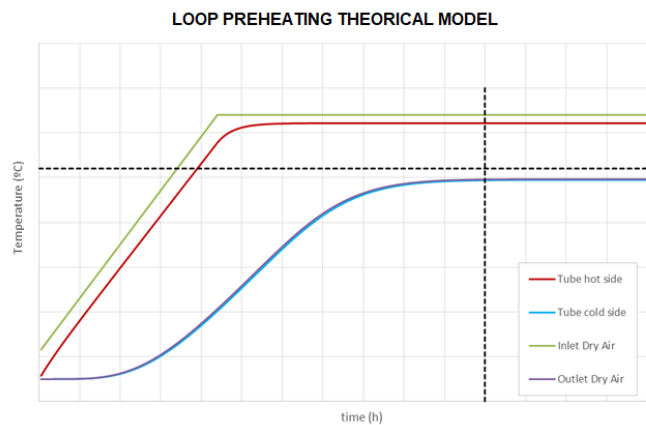
# SOLAR FIELD PREHEATING SYSTEM – MSLOOP TESTS

- ✓ HEATING MEDIUM → HOT & COMPRESSED NITROGEN
- ✓ TWO INLET TEMPERATURE RAMPS → ABSORBER TUBE BEHAVIOUR
- ✓ CONTROL OF TEMPERATURE EVOLUTION ALONG THE LOOP

## MSLOOP PREHEATING TESTS

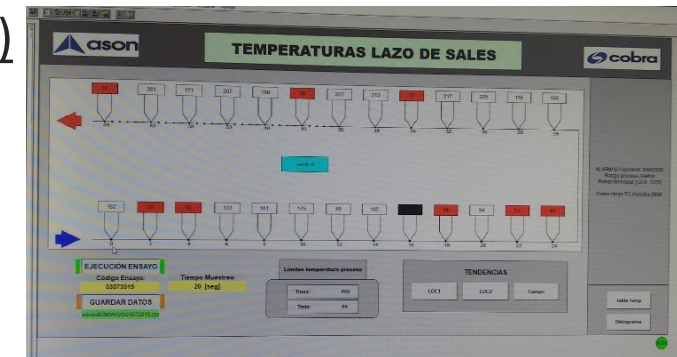


### LOOP PREHEATING SIMULATION MODEL



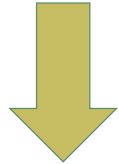
### LOOP PREHEATING TESTS (Executed last 3<sup>rd</sup> of July)

Test	Nitrogen flowrate (kg/h)	Heating ramp	Nitrogen inlet temperature	End of preheating test
e1	M1	5°C/min	Acc. to MOLTEN SALT operation temperature	
e2	M1	26°C/min		



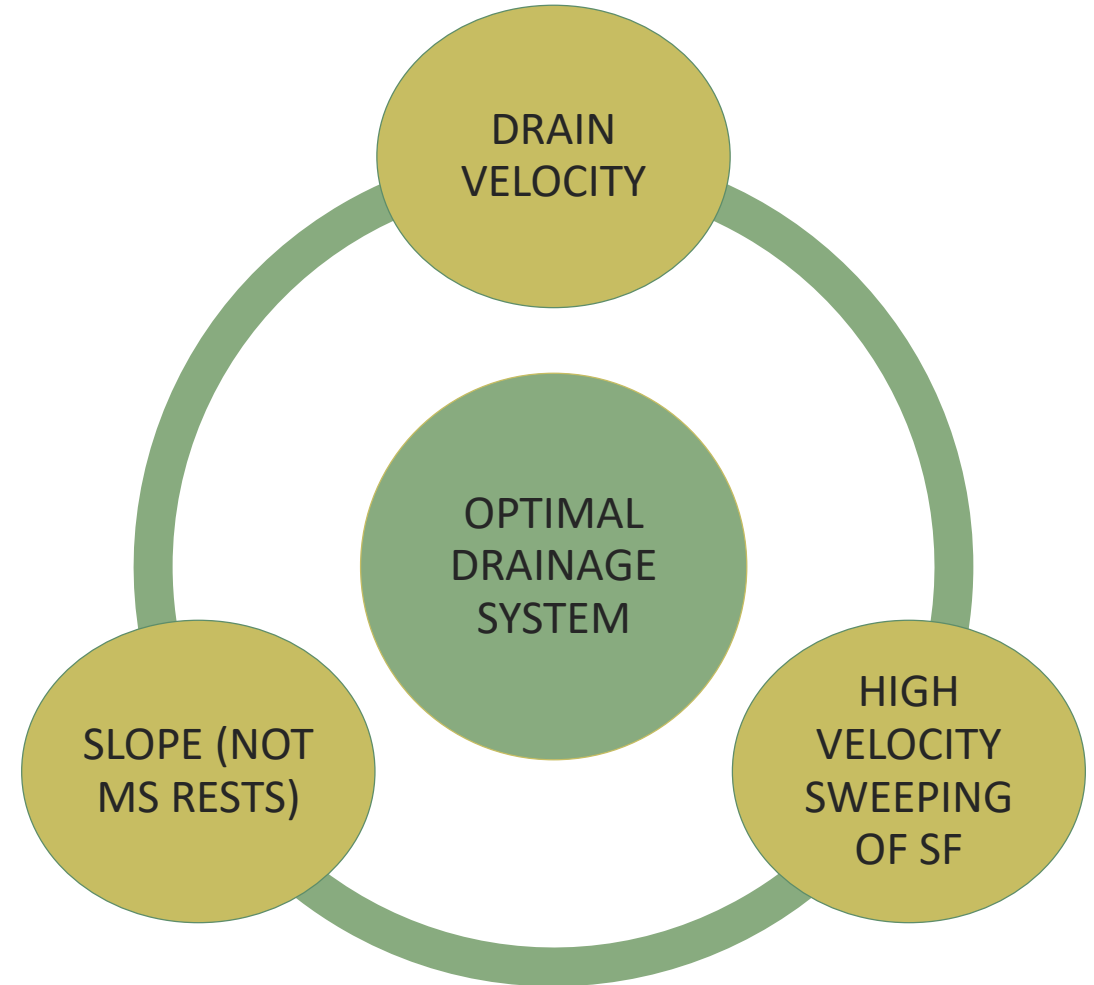


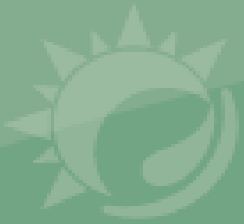
## DRAINAGE OPERATION IN A SOLAR FIELD OPERATING WITH MOLTEN SALTS



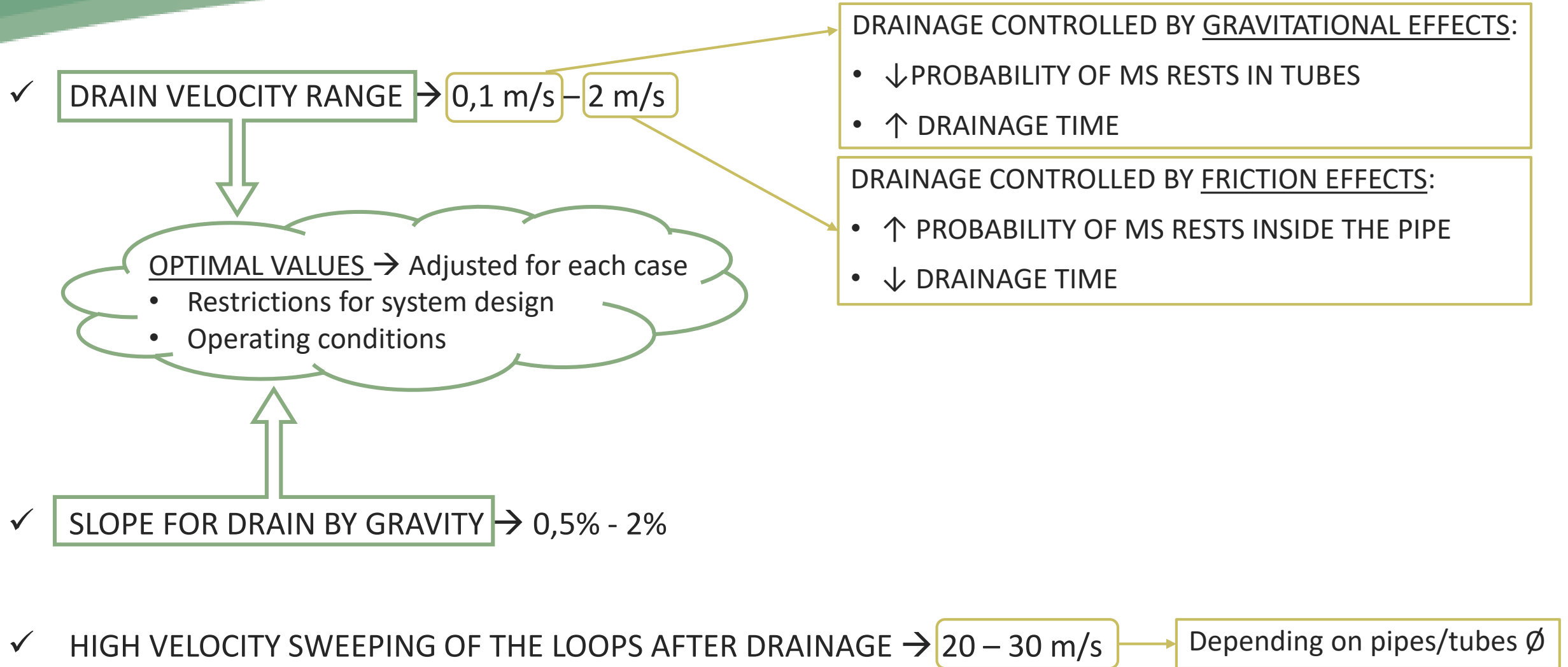
SOLAR FIELD SLOPE INFLUENCE

DRAIN VELOCITY INFLUENCE





# DRAINAGE SYSTEM







# MSLOOP



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***THANK YOU  
FOR YOUR ATTENTION***

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 **MSLOOP**

