CLEAN DEVELOPMENT MECHANISM

AMS-III.BI

Small-scale Methodology

Flare gas recovery in gas treating facilities

Version 01.0

Sectoral scope(s): 10

United Nations
Framework Convention on
Climate Change

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	This methodology is applicable for off-spec gas capture and injection into a gas sales line for transportation to the market after cleaning/processing and compressing in dedicated project facilities
Type of GHG emissions mitigation action	Recovering the waste off-spec gas and utilizing for useful applications

2. Scope, applicability, and entry into force

2.1. Scope

2. The methodology is applicable to project activities that recover off-spec gas from existing natural gas processing facilities (GPF) and utilize as a feedstock in the facility. In the absence of the project activity, off-spec gas is either completely flared or partially flared and partially used for captive energy production.

2.2. Applicability

3. The methodology is applicable under the following conditions:

(a) Off-spec gas from GPF, used by the project activity, totally or partially was flared (not vented) for at least three years, prior to the start date of the project. This shall be demonstrated through the availability of at least three years historical operational data of the amount of off-spec gas flared in the GPF;

(b) Recovered off-spec gas in the project activity should be captured, compressed, and cleaned/processed in the GPF before being injected into a gas sales line for transportation to the market;

(c) Off-spec gas volume, energy content and composition are measurable;

(d) There shall not be any addition of fuel gas or dry gas into the off-spec gas pipeline between the point of recovery and the point where it is fed into the GPF;

(e) Measures are limited to those that result in emission reductions of less than or equal to 60 $ktCO_2$ equivalent annually.

2.3. Entry into force

4. The date of entry into force is the date of the publication of the EB 75 meeting report on 4 October 2013.

3. Normative references

5. Project participants shall apply the "General guidelines for SSC CDM methodologies" and the "Guidelines on the demonstration of additionality of small-scale project activities" (previously known as attachment A to appendix B) provided at: <http://cdm.unfccc.int/methodologies/SSCmethodologies/approved.html> mutatis mutandis

6. This methodology is based on the proposed small scale methodology "Flare Gas Recovery in Gas Treating Facilities" which has been proposed by Research Institute for Petroleum Industry and Mehr Renewable Energies Co for Flare Gas Recovery Project at Sarkhoon and Qeshm Gas Treating Company (SQGC).

7. This methodology refers to the latest version of the following methodological tools and guidelines[1] mutatis mutandis:

   (a) "General guidelines for SSC CDM methodologies";

   (b) "Guidelines on the demonstration of additionality of small-scale project activities";

   (c) "Tool to calculate baseline, project and/or leakage emissions from electricity consumption";

   (d) "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

   (e) "Tool to calculate the emission factor for an electricity system";

   (f) The methodological tool "Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period";

   (g) "General guidelines for SSC CDM methodologies";

   (h) "Guidelines on the demonstration of additionality of small-scale project activities.

4. Definitions

8. The definitions contained in the Glossary of CDM terms shall apply.

9. For the purpose of this methodology, the following definitions also apply:

   (a) **Natural gas processing facility (GPF)** - is a facility designed to clean raw natural gas by separating impurities and various non-methane hydrocarbons and fluids for the purpose of producing sales quality dry natural gas (also known as pipeline quality dry natural gas) and other marketable constituents including condensates, C3/C4[2] streams and sometimes other substances such as sulphur;

   (b) **Dry gas (product gas)** - is dry natural gas that is usually the main product of a GPF. The principal constituent of dry gas is methane, with smaller fractions of ethane, propane, butane, etc.;

[1] Please refer to: <https://cdm.unfccc.int/Reference/index.html>.

[2] Propane (C_3H_8) and Butane (C_4H_{10}).

(c) **Off-spec gas** - is an undesired low pressure by-product generated in several processing units of the GPF and in normal operational processes may be partially used for on-site fuel gas consumption and the remaining unused quantity is flared. The principal constituents of this gas are the same as dry gas, but at a much lower pressure and lower methane content compared to the dry gas;

(d) **Raw gas** - the main gas stream which is fed to the process units and processed to produce dry gas, condensates and the C3/C4 stream at a GPF;

(e) **Fuel gas** - the gas which is used as fuel in the GPF to supply the required energy.

5. Baseline methodology

5.1. Project boundary

10. The physical, geographical site of the GPF where the off-spec gas is produced, captured and treated in project dedicated facilities delineates the project boundary.

Table 2. Emission sources included in or excluded from the project boundary

Source		Gas	Included	Justification/Explanation
Baseline	Flaring and Fuel Gas combustion for on-site consumption	CO_2	Yes	Main source of emissions in the baseline
		CH_4	No	It is assumed that complete oxidation of carbon is occurred in flaring and fuel gas combustion processes. It is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Electrical power consumption for baseline	CO_2	Yes	Main source of emissions in the baseline
Project activity	Dry Gas combustion for on-site consumption (including the project activity facilities)	CO_2	Yes	Main source of emissions in the project activity
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible
	Electrical power consumption for project	CO_2	Yes	Main source of emissions in the project activity
		CH_4	No	Assumed negligible
		N_2O	No	Assumed negligible

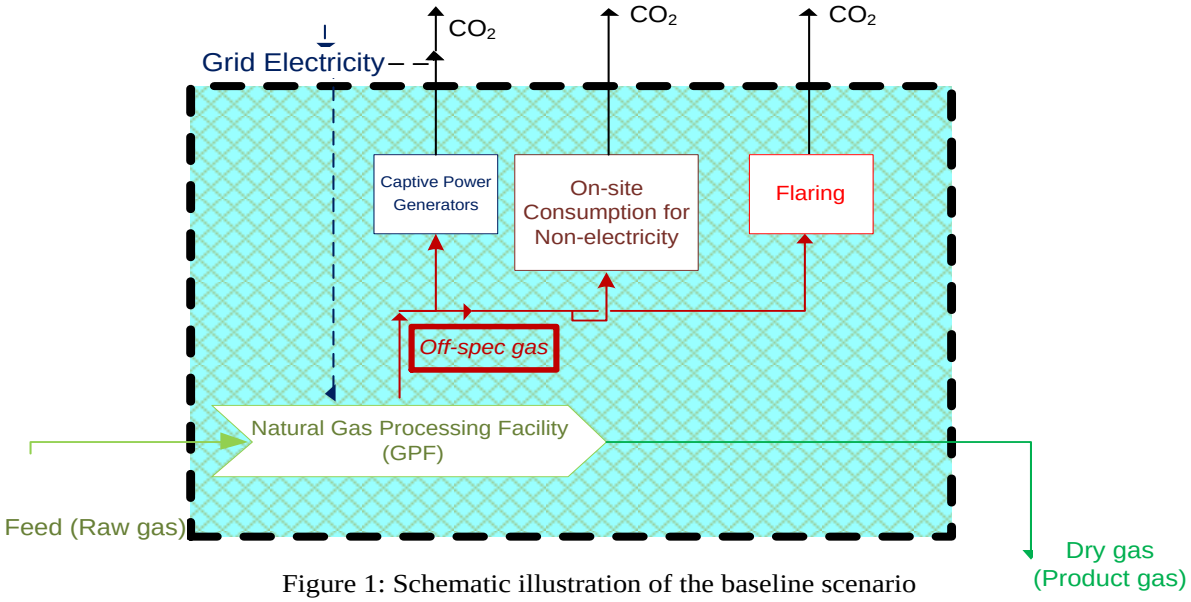

Figure 1: Schematic illustration of the baseline scenario

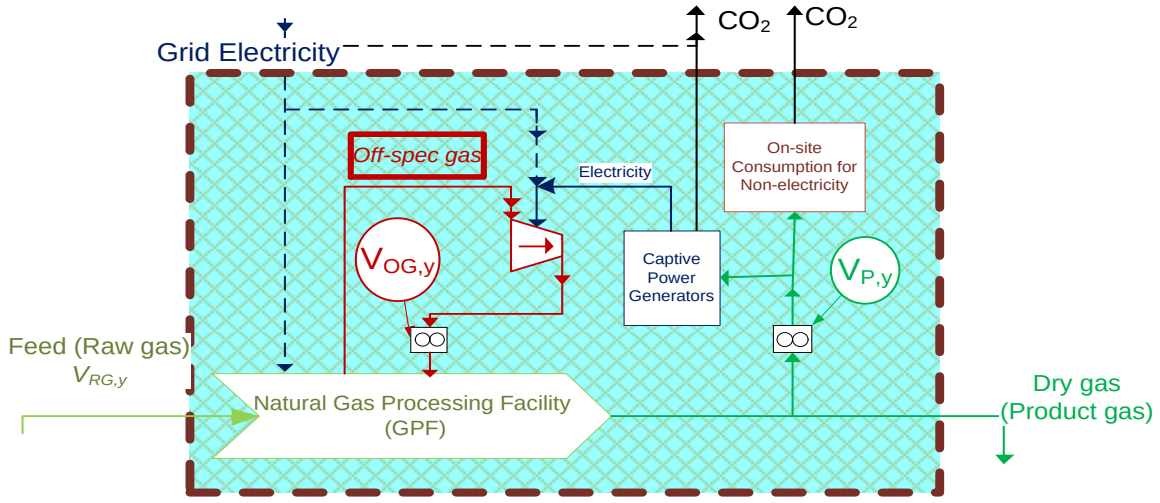

Figure 2: Schematic illustration of the project activity

flow meter

5.2. Baseline emissions

11. In absence of the project activity the off-spec gas produced in the baseline scenario would be total or partial flaring. When partially flared, the balance off-spec gas is used as fuel gas in the GPF.

12. In calculating baseline emissions:

    (a) The off-spec gas would be flared and/or consumed as fuel gas in the GPF in the absence of the project activity;

    (b) All carbon (i.e. in methane and other gases including other non-methane hydrocarbons) in the off-spec gas is completely oxidized to CO_2. Baseline emissions are calculated as follows:

$$BE_y = BE_{FFC,y} + BE_{EC,y} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions during the year *y* (t CO_2e)
$BE_{FFC,y}$	=	Baseline emissions from flaring and fuel gas combustion (excluding the fuel gas consumption for electricity generation, if any) in year *y* (t CO_2e)
$BE_{EC,y}$	=	Baseline emissions from electricity consumption in year *y* (t CO_2e)
y	=	Project year

5.2.1. Baseline emissions from flaring and fuel gas combustion

13. Baseline emissions ($BE_{FFC,y}$) due to flaring and fuel gas combustion are calculated as follows:

$$BE_{FFC,y} = V_{OGEN,y} \times W_{C,y}/1000 \times 44/12 \quad \text{Equation (2)}$$

Where:

$V_{OGEN,y}$	=	Net amount of off-spec gas eligible for crediting in year *y* (m^3)
$W_{C,y}$	=	The carbon content of off-spec gas recovered in year *y* (kg C/m^3)

$$V_{OGEN,y} = V_{OGE,y} - V_{OGP} \quad \text{Equation (3)}$$

Where:

$V_{OGE,y}$	=	Total amount of off-spec gas eligible for crediting in year *y* (m^3)
V_{OGP}	=	The average of off-spec gas used for electricity generation in the GPF based on at least three years historical operational data of the GPF (m^3/year)

5.2.2. Capping of amount of off-spec gas

14. As an introduction of element of conservativeness, this category requires that amount of off-spec gas shall be capped irrespective of planned/unplanned or actual increase in output of plant, change in operational parameters and practices, change in fuels type and quantity resulting in increase in off-spec gas generation. The amount of off-spec gas that is eligible for claiming emissions reductions ($V_{OGE,y}$) is capped by the historic generation of off-spec gas in absolute and relative term, as follows:

$$V_{OGE,y} = Min\ (V_{OG,y}, V_{OGHA,} V_{OGHR,y}) \quad \text{Equation (4)}$$

Where:

$V_{OG,y}$ = Total amount of off-spec gas recovered in year *y* at a point where it enters to the GPF (m^3)

V_{OGHA} = The average off-spec gas generated in the GPF (m^3). This parameter shall be based on at least three years of historical operational data of the GPF

$V_{OGHR,y}$ = The theoretical amount of off-spec gas generated in the year *y* calculated using the raw gas production in year *y*, and the historic ratio of off gas to raw gas production (m^3)

$$V_{OGHR,y} = \frac{V_{OGHA}}{V_{RGHA}} \times V_{RG,y} \quad \text{Equation (5)}$$

Where:

$V_{RG,y}$ = Amount of raw gas entering in the GPF in year *y* (m^3)

V_{RGHA} = The average of raw gas entering in the GPF (m^3).
This parameter shall be based on at least three years historical operational data of the GPF

5.2.3. Baseline emissions from consumption of electricity

15. Baseline emissions due to the use of electricity for GPF in the absence of project activity ($BE_{EC,y}$) are calculated applying the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" where the electricity consumption sources *k* in the tool corresponds to all sources of electricity consumption in baseline. This parameter shall be fixed ex ante based on at least three years of the historical operational data of the GPF.

5.3. Project emissions

16. Project emissions[3] are calculated as follows:

$$PE_y = PE_{FC,y} + PE_{EC,y} \quad \text{Equation (6)}$$

Where:

PE_y = Project emissions in year *y*, (t CO_2e)

$PE_{FC,y}$ = Project emissions due to on-site combustion of dry gas as fuel for the total on-site consumption including the captive power plant and the demands of the project activity (recovery, transportation, and compression of the recovered off-spec gas) in year *y*, (t CO_2e)

$PE_{EC,y}$ = Project emissions from electricity consumption (excluding captive electricity generation, if any) for the project activity demands (recovery, transportation, and compression of the recovered off-spec gas) in year *y* (t CO_2e)

5.3.1. Project emissions from the combustion of fuel gas

17. Project emissions due to the combustion of dry gas as fuel ($PE_{FC,y}$) are calculated applying the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion" where process *j* corresponds to all sources of fuel combustion (e.g. a compressor, etc.) in the project boundary.

5.3.2. Adjustment for project emissions from combustion of fuel gas

18. The energy generated on-site using combustion of dry gas ($E_{O,y}$) shall be compared with the historical average onsite energy generation (E_{OEO}) as follows:

$$E_{OEO} = \frac{\sum_{i=1}^{n} V_{OGE,i} \times NCV_{OG,i}}{n} \quad \text{Equation (7)}$$

Where:

E_{OEO} = The average of onsite energy generation using off-spec gas as fuel gas in the GPF based on at least three years historical operational data of the GPF (GJ)

$V_{OGE,i}$ = The amount of off-spec gas used for energy generation in the GPF in historical year *i* (m^3)

[3] Other sources of project emissions such as emissions from leaks, venting and flaring during the recovery, transportation and processing of recovered gas are assumed to be of similar magnitude in the baseline scenario.

$NCV_{OG,i}$ = The net calorific value of off-spec gas in the GPF in historical year *i* (GJ/m^3)

n = Number of historical years for which data is available. For this methodology $n \geq 3$

$$E_{O,y} = V_{P,y} \times NCV_{P,y} \quad \text{Equation (8)}$$

Where:

$E_{O,y}$ = Energy generated on-site in year *y* using dry gas produced in the project activity in year *y* (GJ)

$V_{P,y}$ = Volume of dry gas consumed on-site for energy generation in the project activity in year *y* (m^3)

$NCV_{P,y}$ = Net calorific value of dry gas produced in the project activity in year *y* (GJ/m^3)

19. The following rules to be followed to determine the volume of dry gas used for onsite energy generation in year *y* that will be used for calculation of the project emissions from consumption of fuel gas:

(a) If $E_{OEO} > E_{O,y}$ then the volume of dry gas that will be used for calculation of the project emissions from consumption of fuel gas shall be estimated as follows:

$$V_{P,y} = \frac{E_{OEO}}{NCV_{P,y}} \quad \text{Equation (9)}$$

(b) If $E_{OEO} \leq E_{O,y}$ then the volume of dry gas that will be used for calculation of the project emissions from consumption of fuel gas will be the actual amount of dry gas monitored as used for onsite energy generation in year *y*.

5.3.3. Project emissions from consumption of electricity

20. Project emissions due to the use of electricity for GPF including the project activity ($PE_{EC,y}$) demands (e.g. compression of the recovered off-spec gas) are calculated applying the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption" where the electricity consumption sources *j* in the tool corresponds to all sources of electricity consumption in year *y*. For this mean the volume of electricity which is produced by captive power plant is deducted from total electricity consumption of the plant in year y and then the net amount is used for estimation of the project emission from consumption of electricity.

5.4. Leakage

21. No leakage calculation is necessary.

6. Monitoring methodology

22. Relevant parameters shall be monitored as indicated in the table below. The applicable requirements specified in the "General guidelines for SSC CDM methodologies" are also an integral part of the monitoring guidelines specified below and therefore shall be referred by the project participants.

6.1. Data and parameters monitored

23. The following parameters shall be fixed ex ante at the time of validation.

Data / Parameter table 1.

Data / Parameter:	**$BE_{EC,y}$**
Data unit:	t CO_2e/year
Description:	Baseline emissions due to electricity consumption in the GPF in year *y*
Source of data:	-
Measurement procedures (if any):	Baseline emissions due to electricity consumption in the GPF calculated applying the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Monitoring frequency:	Fixed ex ante
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 2.

Data / Parameter:	**V_{OGP}**
Data unit:	m^3/year
Description:	Average baseline off-spec gas consumption for electricity generation inside GFP based on at least three years of the historical operational data of the GPF
Source of data:	Plant records
Measurement procedures (if any):	-
Monitoring frequency:	Fixed ex ante
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 3.

Data / Parameter:	**$V_{OGE,i}$**
Data unit:	m^3/year

Description:	The amount of off-spec gas used for energy generation in the GPF in historical year *i*
Source of data:	Plant records
Measurement procedures (if any):	-
Monitoring frequency:	Fixed ex ante
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 4.

Data / Parameter:	**$NCV_{OG,i}$**
Data unit:	GJ/m^3
Description:	The net calorific value of off-spec gas in the GPF in historical year *i*
Source of data:	Plant records
Measurement procedures (if any):	-
Monitoring frequency:	Fixed ex ante
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 5.

Data / Parameter:	**V_{OGHA}**
Data unit:	m^3/year
Description:	The amount of off-spec gas generated in the GPF based on at least three years of the historical operational data of the GPF
Source of data:	Plant records
Measurement procedures (if any):	-
Monitoring frequency:	Fixed ex ante
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 6.

Data / Parameter:	**V_{RGHA}**
Data unit:	m^3/year
Description:	The amount of average raw gas entering in the GPF based on at least three years of the historical operational data of the GPF
Source of data:	Plant records

Measurement procedures (if any):	-
Monitoring frequency:	Fixed ex ante
QA/QC procedures:	-
Any comment:	-

24. The following parameters shall be monitored and recorded during the crediting period.

Data / Parameter table 7.

Data / Parameter:	**$V_{OG,y}$**
Data unit:	m^3/year
Description:	The volume of off-spec gas utilized in year *y* at the point enters to the GPF
Source of data:	Plant records
Measurement procedures (if any):	Data should be measured using accurate and calibrated flow meters. Measurements should be taken at the point the recovered off-spec gas enters to the GPF
Monitoring frequency:	Monthly
QA/QC procedures:	The metering equipment shall be calibrated either in accordance with the specifications of the company procedures or local/national standards, or as per the manufacturer specification. If local/national standards or the manufacturer specification is not available, international standards (e.g. IEC, ISO). may be followed
Any comment:	Meters with capability of online conversion to standard condition. This value is compared with the minimum cap of baseline and the smaller one is selected to calculate the emission of baseline scenario

Data / Parameter table 8.

Data / Parameter:	**$V_{RG,y}$**
Data unit:	m^3/year
Description:	Amount of raw gas entering in the GPF in year *y*
Source of data:	Plant records
Measurement procedures (if any):	Data should be measured using accurate and calibrated flow meters. Measurements should be taken at the point the raw gas enters to the GPF
Monitoring frequency:	Monthly
QA/QC procedures:	The metering equipment shall be calibrated either in accordance with the specifications of the company procedures or local/national standards, or as per the manufacturer specification. If local/national standards or the manufacturer specification is not available, international standards (e.g. IEC, ISO) may be followed
Any comment:	Meters with capability of online conversion to standard condition

Data / Parameter table 9.

Data / Parameter:	**$W_{C,y}$**
Data unit:	kgC/m^3
Description:	Average carbon content of off-spec gas in year *y*
Source of data:	Plant records
Measurement procedures (if any):	Analysis can be performed quarterly in conjunction with measurement of the of the chemical analysis for methane content (e.g. gas chromatography) of the off-spec gas
Monitoring frequency:	Annual as average of the quarterly results
QA/QC procedures:	Carbon content of gas should be cross checked with previous months' data as well as with the owners of the GPF
Any comment:	-

Data / Parameter table 10.

Data / Parameter:	**$V_{P,y}$**
Data unit:	m^3/year
Description:	The volume of dry gas which is routed as fuel gas for on-site consumption in year *y*
Source of data:	Plant records
Measurement procedures (if any):	Data should be measured using accurate and calibrated flow meters. Measurements should be taken at the point which is close as close to the dry gas pipeline
Monitoring frequency:	Monthly
QA/QC procedures:	The metering equipment shall be calibrated either in accordance with the specifications of the company procedures or local/national standards, or as per the manufacturer specification. If local/national standards or the manufacturer specification is not available, international standards (e.g. IEC, ISO) may be followed
Any comment:	Meters with capability of online conversion to standard condition. This value is compared with the historical consumption of project activity and the bigger one is selected to calculate the emission of project activity

Data / Parameter table 11.

Data / Parameter:	**$NCV_{P,y}$**
Data unit:	GJ/m^3
Description:	The net calorific value of dry gas produced in the project activity in year *y*
Source of data:	Plant records
Measurement procedures (if any):	-

Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 12.

Data / Parameter:	**$PE_{EC,y}$**
Data unit:	t CO_2e/year
Description:	Project emissions due to electricity consumption in the GPF in year *y*
Source of data:	-
Measurement procedures (if any):	Project emissions due to electricity consumption in the GPF calculated applying the latest approved version of the "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 13.

Data / Parameter:	**$PE_{FC,y}$**
Data unit:	t CO_2e/year
Description:	Project emissions due to fuel gas consumption in the GPF in year *y*
Source of data:	-
Measurement procedures (if any):	Project emissions due to combustion of dry gas as fuel for the total on-site consumption in the GPF calculated applying the latest approved version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

Data / Parameter table 14.

Data / Parameter:	**$E_{EC,y}$**
Data unit:	kWh/year
Description:	The quantity of electricity generated by captive power plant in year *y*
Source of data:	Plant records
Measurement procedures (if any):	-
Monitoring frequency:	Monthly
QA/QC procedures:	-
Any comment:	-

6.2. Project activity under a programme of activities

25. In case the project activity involves the replacement of equipment, and the leakage effect of the use of the replaced equipment in another activity is neglected, because the replaced equipment is scrapped, an independent monitoring of scrapping of replaced equipment needs to be implemented. The monitoring should include a check if the number of project activity equipment distributed by the project and the number of scrapped equipment correspond with each other. For this purpose scrapped equipment should be stored until such correspondence has been checked. The scrapping of replaced equipment should be documented and independently verified.

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Document information

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